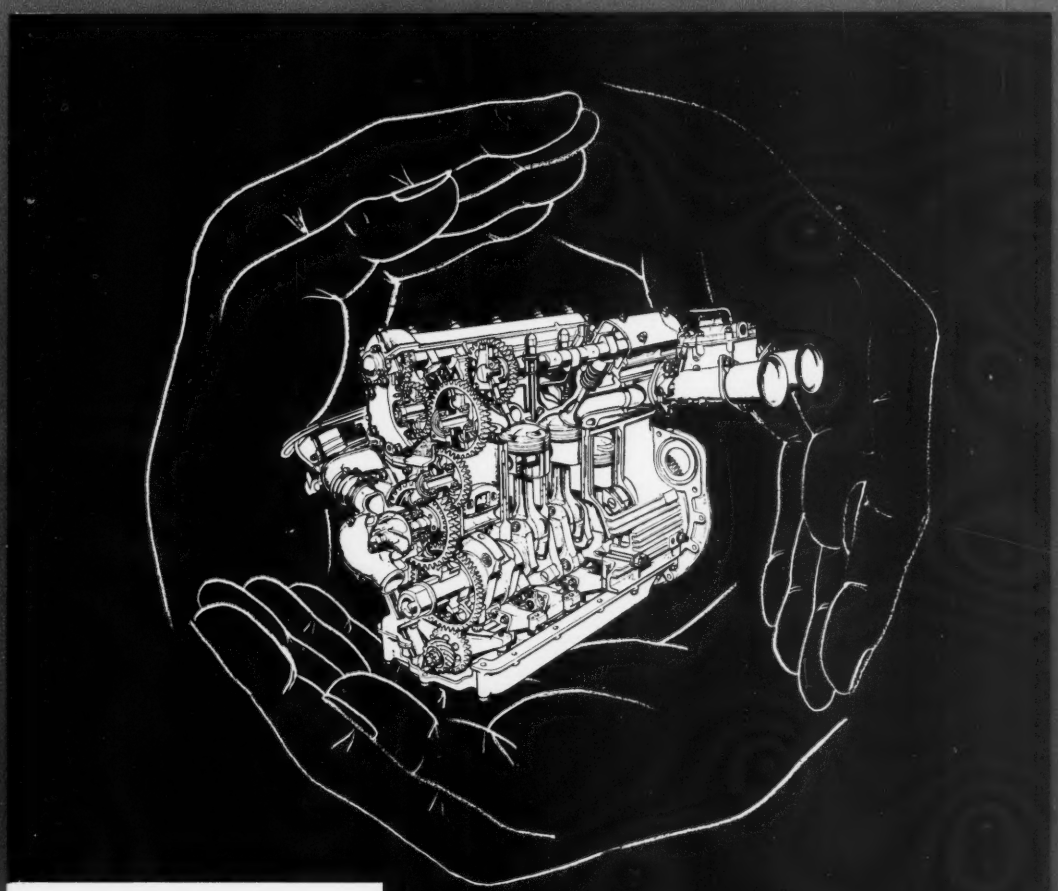
Vol. 16, No. 5 May, 1960

LUBRICATION ENGINEERING

DESIGN RESEARCH APPLICATION EDUCATION MAINTENANCE



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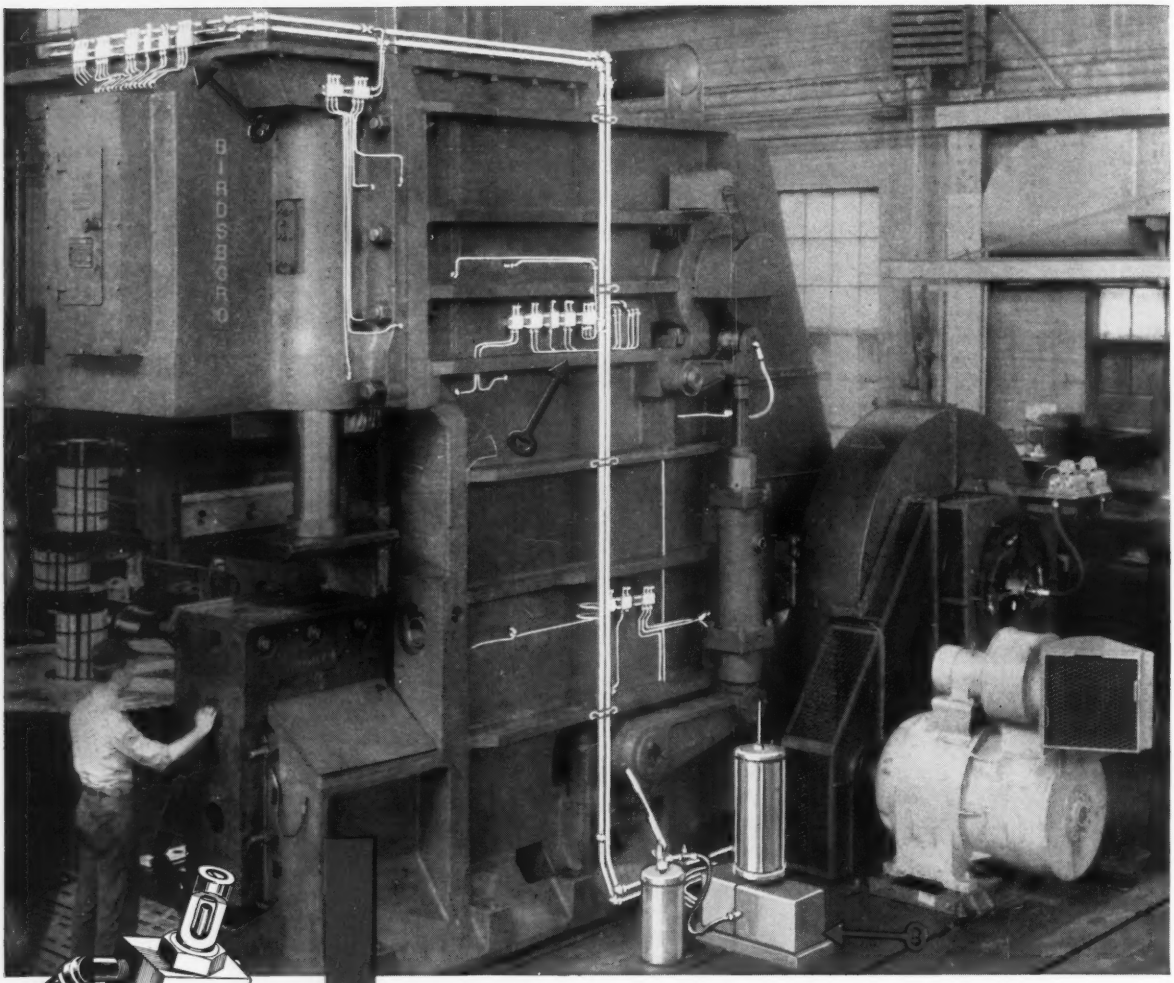
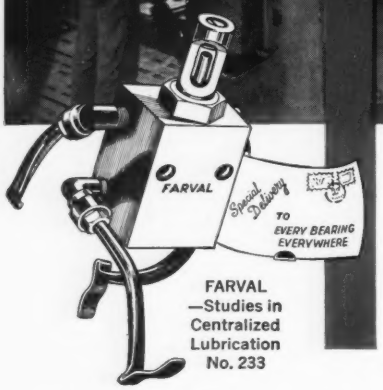
Engine Lubrication

JOURNAL OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS





FARVAL
—Studies in
Centralized
Lubrication
No. 233

Farval automatically lubricates 61 bearings on this Birdsboro Shear at Sharon Steel Corporation

This giant 1000-ton Birdsboro hot bloom and slab shear—largest of its type—completes a cut in only 4½ seconds. Actual cutting is done by the rising action of the up-and-down cut shear's bottom knife—gives square-cut ends free from hook.

Keeping this heavy-duty cycle machine in production around-the-clock requires continuous, positive lubrication. So a modern motor-driven Farval system was installed. It's time clock controlled to eliminate the human element—makes sure the shear's 61 bearings are never without proper lubrication.

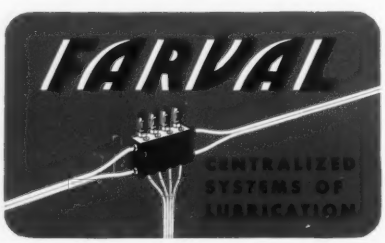
Remember, for the ultimate in bearing protection on any of your production machines—it's Farval. For the latest information on what Farval can do in your plant, write for free Bulletin 26-T.

Farval Division • Eaton Manufacturing Company
3267 East 80th Street • Cleveland 4, Ohio

EATON

KEYS TO ADEQUATE LUBRICATION

Wherever you see the sign of Farval —familiar valve manifolds, dual lubricant lines and central pumping station—you know a machine is being properly lubricated.



Volume 16, No. 5
May, 1960

Lubrication Engineering

DESIGN RESEARCH APPLICATION EDUCATION MAINTENANCE

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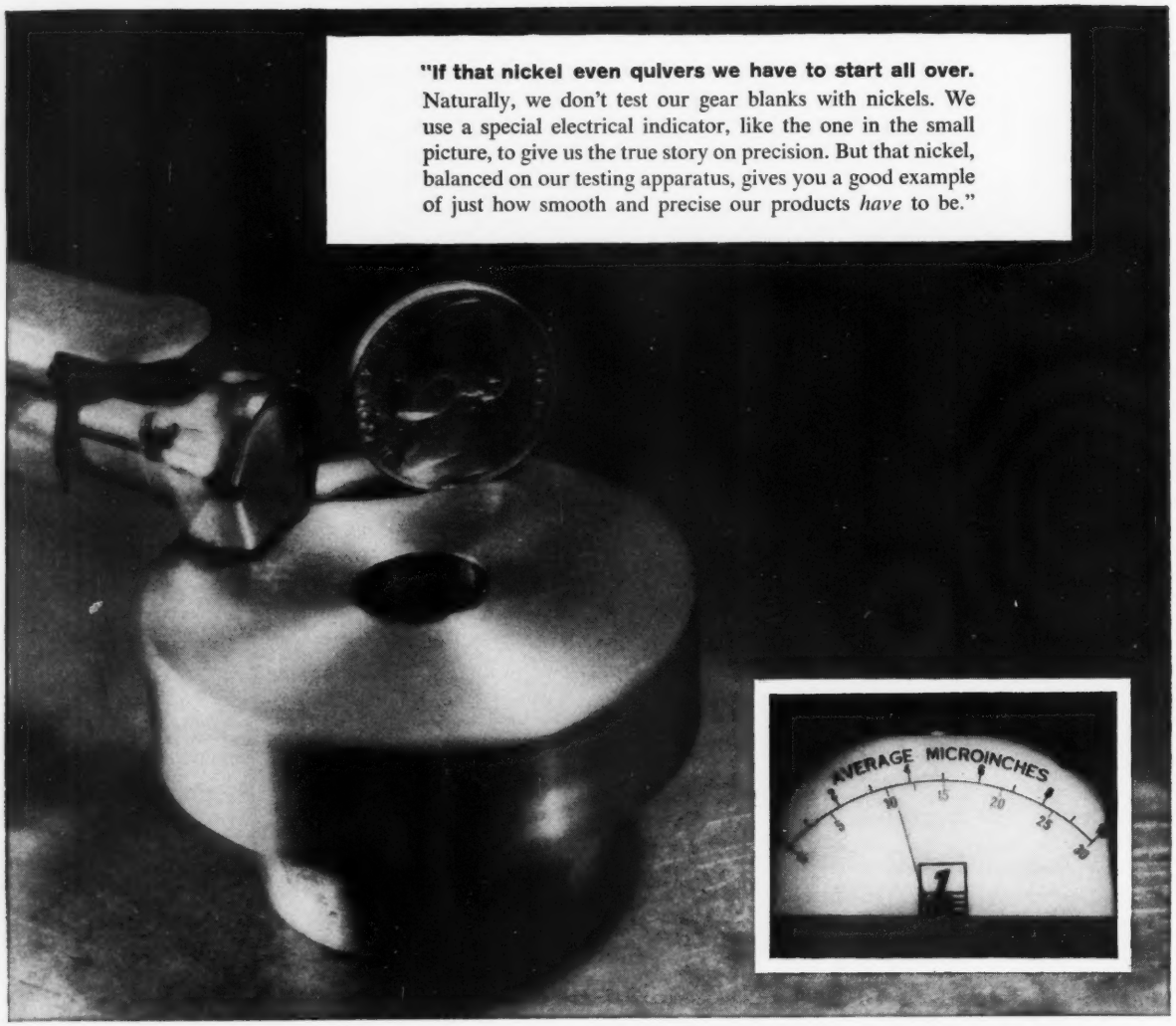

"If that nickel even quivers we have to start all over.
Naturally, we don't test our gear blanks with nickels. We use a special electrical indicator, like the one in the small picture, to give us the true story on precision. But that nickel, balanced on our testing apparatus, gives you a good example of just how smooth and precise our products *have* to be."
AVERAGE MICROINCHES
5
10
15
20
25
30

"We depend on Cities Service for absolute precision!"

Lester E. Hoffmann, Treasurer and Vice-President
American Screw Machine Products Co., Chicago, Ill.

"The screw machine business is a highly competitive trade. We've built our business and our reputation on top quality, high-precision products . . . gear blanks that require the closest tolerances in *all* aspects. That means *we have to have* the best-quality cutting oil available. We've depended on Cities Service for nearly 25 years and they've never let us down."

"Matter of fact," says Mr. Hoffmann, "they insisted we try other brands just to prove that Cities Service was the best for us. They proved their point. We've stuck with Cities Service."

At the present time, American Screw Machine Products Co. is using Cities Service CHILLO 10 Cutting oil, and some CHILLO 22. As Mr. Hoffmann says, "The sulphur and chlorine additives prevent welding and galling action which allows for fine finishes and long tool life that maintains high-precision, top-quality work."

If you use petroleum products in your operations, why not talk with your Cities Service Lubrication Engineer? He can help you get the most from your operations by giving you the finest products, the best service available. Or if you prefer, write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

LUBRICATION IN THE NEWS

The Society will not be responsible for the accuracy of statements made in this column. Any reference to proprietary products does not imply an endorsement of such products by the Society.

GORDON RESEARCH CONFERENCES

The Gordon Research Conferences for 1960 will be held from June 13 to September 2 at Colby Junior College, New London, N. H.; New Hampton School, New Hampton, N. H.; and Kimball Union Academy, Meriden, N. H.

The conferences were established to stimulate research in universities, research foundations, and industrial laboratories. This purpose is achieved by an informal type of meeting consisting of scheduled lectures and discussion groups. Scheduled for June 13th at Colby Junior College is a week long session on "Petroleum: Friction, Lubrication, and Wear." Chairman of this session is William A. Horne, Vice Chairman, Cheves Walling. June 13—Douglas Godfrey, "Boundary Lubrication;" G. V. Vinogradov, "Fundamentals of Extreme Pressure Lubrication." June 14—G. S. Reichenbach, "Friction and Ball Bearings;" J. M. Bailey, "Plastic and Elastic Deformations in Single Crystals." June 15—R. L. Johnson, "Lubrication at Extremely Low and Extremely High Temperatures;" D. G. Flom, "Friction and Lubrication of Plastics." June 16—B. G. Rightmire, "Hydrodynamics of Lubrication;" R. J. S. Pigott, "Bearings, What are They?" June 17—John Boyd, "Electrostatic Effects in Lubrication."

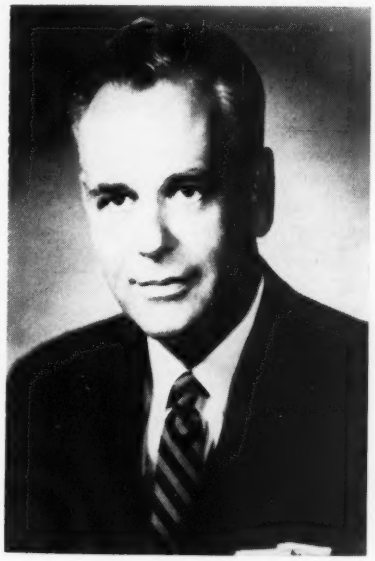
Attendance at the conferences is by application. Individuals interested in attending the conferences are requested to send their applications to the director at least 2 months prior to the date of the conference. All applications must be submitted on the standard application form, which may be obtained by writing to the office of the director, W. George Parks, Director, Department of Chemistry, University of Rhode Island, Kingston, R. I. (Source: American Association for the Advancement of Science)

PHILLIPS PETROLEUM GIVEN NSPE AWARD

Phillips Petroleum Company will be awarded a plaque citing the firm for "its record of advancement and improvement of the engineering profession through development and use of forward-looking engineering employment practices in accord with professional standards." The selection of Phillips for the Award was made by an Industrial Award Committee of the National Society of Professional Engineers after an extensive study of engineering employment practices in industrial firms throughout the country. (Source: National Society of Professional Engineers)

MECHANICAL PACKING ASSOCIATION ELECTS OFFICERS

Richard B. Hazard, vice president of Raybestos-Manhattan, Inc., has been re-elected president of the Mechanical Packing Association, Inc.



RICHARD B. HAZARD

Hazard, who was again elected to the Association's key post at the February 25 meeting at the Union League Club, New York City, has had extensive background in mechanical packings and rubber products, having been sales manager for Raybestos-Manhattan for eight years and vice president for the last four.

A member of The Mechanical Packing Association since 1952, Hazard has previously served as vice president and chairman of the Standards and Specifications Committee.

Other officers and posts to which they have been re-elected are: J. Bert Sewell, Garlock Packing Company—vice president; Fred H. Luhrs, Association secretary-treasurer; and George Link, Jr.—counsel. (Source: Mechanical Packing Association, Inc.)

AIR BEARING CUTS FRICTION SHARPLY; RATED HIGH FOR SPACE WORK

Lubrication hit the front page of the *Wall Street Journal* just recently with a story about air and gas lubricated bearings. It seems that the theoretical studies of this method of lubrication are now getting management attention and the search is being extended to the "four corners" to uncover applications. As reported in the article, a number of firms are experimenting with air and gas lubricated bearings that might be used in space vehicles where conventional bearing lubricants are inadequate. A major appliance firm in its search for an electric motor that would not be affected by cold temperatures for use in propelling fans to circulate air in refrigerators has found this application quite attractive. The situation is being thoroughly explored. (Source: *Wall Street Journal,* April 13, 1960)

A.S.T.E. OFFERS REVISED TOOL ENGINEERING HANDBOOK

The American Society of Tool Engineers has drawn from the pooled experience of some 40,000 A.S.T.E. members in its endeavor to present an authoritative and up-to-date reference source covering the mechanical processes employed in engineering raw materials into finished products.

With the revised edition of "Tool Engineers Handbook," A.S.T.E. has sought to make available the newest facts on all phases of planning, control, design, tooling, and operations in the mechanical manufacturing industries.

McGraw-Hill Book Company, Inc., New York, is handling the publication and distribution of the newly revised edition of "Tool Engineers Handbook." (Source: American Society of Tool Engineers)

FILTER MEDIA AND USES DESCRIBED IN NEW BOOKLET

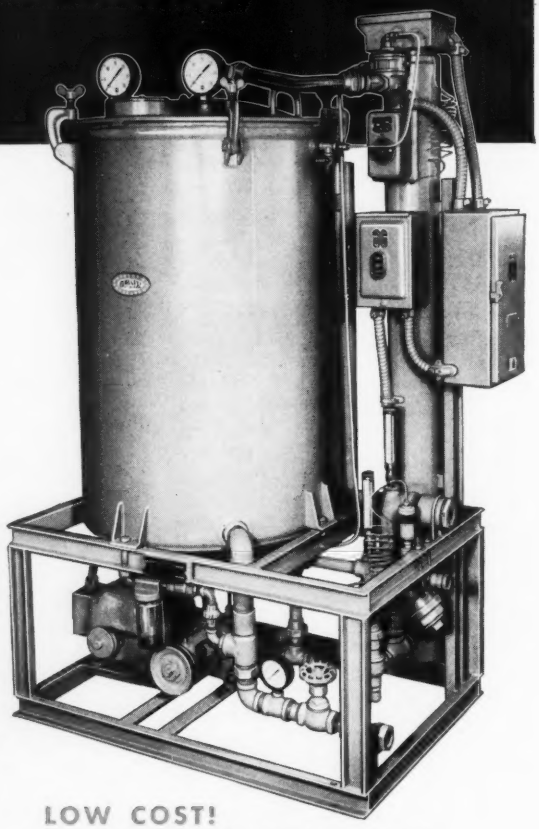
Filtration Products, a new 18-page (8½" × 11") booklet issued by Purolator Products, Inc., lists and details informa-

(Con't. on page 197)

DRY-CLEAN YOUR OIL AT LESS COST WITH

FIL-THERMO-VAC

OFFERS . . . a low cost, highly efficient method of removing WATER and DIRT from lube oils.



FIL-THERMO-VAC ADVANTAGES

- **Proved more effective . . . and costs less than centrifuging.**
- **Results in a drier oil. Equally effective with petroleums or synthetics.**
- **Requires only part-time operator . . . saves man hours.**
- **Serves as an excellent emulsion breaker . . . eliminates need for extra equipment.**
- **Does not remove additives or inhibitors from oil.**

Oil disperses through fiberglas micro-filters into vacuum chamber where water and other volatiles are drawn off . . . condensed and ejected.

LOW COST!

Automatic self-policing "package system" costs less, does better job than any other method. It will pay to get the facts!

BOWSER ESTABLISHED 1885

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Date_____

Gentlemen: Please send 12-page Fil-Thermo-Vac folder to:

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

(*Continued from page 195*)

tion on various filter media for process fluids, nuclear applications, internal combustion engines, hydraulic fluids, machine tool coolants, bulk fuel, and many other applications.

Information provided covers explanation of flow rate, degree of filtration, viscosity of fluids, and reliability for such filtration media as Micronic(R) "paper," metal edge, wire cloth, porous metal media, plus oil absorption and water separation filters, and specially-designed filtration units for high and low temperatures (from minus 420°F to plus 1200°F), high pressure, and corrosive gases and fluids.

For each of the filter media covered in the new booklet, operating specifications are given for range of filtration, temperature limits, flow characteristics, and typical applications and assemblies are used to illustrate ranges.

For copies of the new *Filtration Products* booklet, designated IND-1-60, write: Department 135, Purolator Products, Inc., Rahway, New Jersey. (Source: Purolator Products, Inc.)

HONEYWELL STEPS UP THERMOCOUPLE OUTPUT

Facilities for production of thermocouple and other pyrometer supplies have been expanded by Minneapolis-Honeywell's Brown Instruments Division to meet an increasing industry demand for temperature-sensing elements.

Operations in Philadelphia, principal manufacturing center for the company's industrial process instrumentation, have been streamlined and moved to new quarters.

Assembly and stocking of thermocouples and pyrometer accessories is being carried out in a new plant in Los Angeles set up in 1959 to facilitate distribution in the area west of the Rocky Mountains.

"New and more efficient facilities will enable Honeywell to keep pace with a growing market in the high temperature area and, at the same time, substantially shorten delivery schedules of standard products," said John B. Moxness, Brown Instruments market manager.

High-temperature thermocouples for heat treating, jet engine, missile and rocket engine applications are expected to be an "appreciable" part of the company's sales by the end of 1960, Moxness said. (Source: Minneapolis-Honeywell Regulator Co.)

A complaint filed last fall by the Federal Trade Commission against advertising practices of Micro-Lube prior to September has been disposed of in an agreement reached between the company and FTC officials.

The agreement granted Micro-Lube permission to continue its present advertising program.

Micro-Lube attorneys pointed out that the FTC never contended that there had been any false or misleading claims made regarding the beneficial results that can be obtained by the use of Micro-Lube.

The only complaint registered by the FTC was that some of Micro-Lube's earlier advertising tended to create the impression that the U. S. Air Force officially approves and endorses the use of Micro-Lube.

Defense Department regulations prohibit official endorsement or recommendation by any military establishment of any privately-owned product offered for public sale.

College students planning to enter industry should be trained in the use of computers, say companies recently surveyed by Frank R. Hartman of Pennsylvania State University.

Of the 325 companies answering the poll, 70 per cent have computer facilities and indicate a preference for graduates trained in their use. When asked which curriculums should include computer training, the most frequently mentioned, in descending order, were: mathematics, accounting, electrical engineering, business administration, mechanical engineering, chemical engineering, and physics.

The 325 reporting companies indicated they hired 447 persons for jobs requiring knowledge of computers in 1958, and that they still have 1,031 jobs not filled, or filled with inadequately trained personnel. By 1970, these companies estimate they will have almost 4,000 jobs requiring knowledge of programming, understanding of computer capabilities, and ability to interpret results.

Rapid reading courses are given to professional and technical employees of E. I. du Pont de Nemours, Wilmington, Del. Du Pont engineers used to spend about nine hours a week on job-related reading, but since the start of the course have doubled and in some cases tripled their reading speeds.

(*Con't. on page 204*)

Robert H. Hamilton has been named field engineer for Denison Engineering Division, American Brake Shoe Company, Columbus, Ohio.

Howard R. Medici has been appointed chairman and Glenn L. Pitzer president of Visking Company, division of Union Carbide Corporation. Medici became associated with Union Carbide in 1957 when Visking joined the Corporation. Mr. Pitzer joined Union Carbide in 1933 at the South Charleston, W. Va. laboratory of Union Carbide Chemicals Company. He held a number of positions with the Chemicals Company before being transferred to Union Carbide Plastics Company in 1952. He has been vice president of the Plastics Company since 1936.

T. A. Jonas has been appointed manager, Washington Office for American Potash and Chemicals Corporation. He will maintain local business contacts for the firm's National Northern Division in addition to representing the company with governmental agencies. Jonas replaces J. S. Murray who resigned to enter business as an independent consultant, in which capacity he will continue to perform services for the company.

The appointment of Dr. Kenneth T. Mecklenborg to the Basic Research Department of Emery Industries, Inc. has been announced. He is engaged in mechanism reaction studies and structure determinations currently being conducted by the department. Prior to joining Emery, Dr. Mecklenborg was associated with the Standard Oil Company of Indiana.

Walter P. Krause has been named supervisor, Plant and Sales Technical Service Section of Jefferson Chemical Company's Austin Laboratories. In this position he will be in charge of customer service work requested by the Marketing Department as well as experimental work designed to assist the Manufacturing Department in solving plant problems.

Elanco Products Company, a recently formed division of Eli Lilly and Company, has announced the appointment of Frederic D. Randall as vice president of industrial and home products marketing. Randall will be responsible for all sales, merchandising, and advertising of industrial and home products. He has been with Lilly since 1947.

(*Con't. on page 204*)

NEW PRODUCTS

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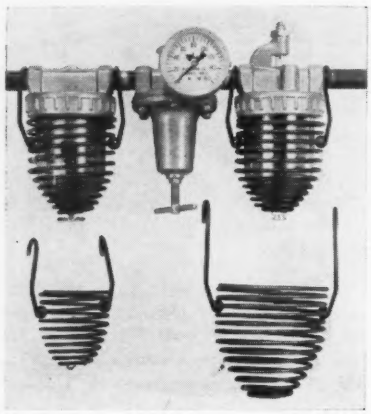
FILTER BOWL PROTECTION OFFERED

"Guard-All" is a new-type protector for the plastic bowls of pneumatic filters and lubricators.



Guard-All's wire cage restrains the flying particles while retaining visibility. Attachment to pipe line is by moveable hooks, easy to adjust for proper height. Explosion tests show the necessity for spacing between bowl and guard. The three Guard-All sizes allow space to give positive protection, and fit all bowls from ¼" through 1". C. W. Morris Co., 10628 Cloverdale, Detroit 4, Michigan.

NEW SILICONE GREASES OFFERED

Two new silicone dielectric greases designed for use in applications subjected to temperature extremes have been introduced by the General Electric Co. Both are soft, workable silicone greases that are chemically inert and can be used over a broad PH range.

The manufacturer reports that these new greases maintain their consistency from −65 F to 400 F and as a result can be used in many applications where conventional greases would either solidify or be subject to oxidation, evaporation and excessive bleed losses. They are reported to offer excellent dielectric properties as well as good water repellency and oxidation resistance.

Additional product data on both of these new silicone greases may be obtained from the Silicone Products Department, General Electric Company, Waterford, New York.

GREASE FEATURES ANTI-WELD PROPERTIES

Lehigh Chemical Company is marketing a synthetic anti-seize compound for extreme high temperature applications.

Called Anderol L-751, it is a mixture of a thermally stable silicone oil with a solid type lubricant blended to the consistency of a medium soft grease. Its excellent thermal stability and anti-weld properties meet the requirements for high temperature ranges of 400°F. to 600°F.

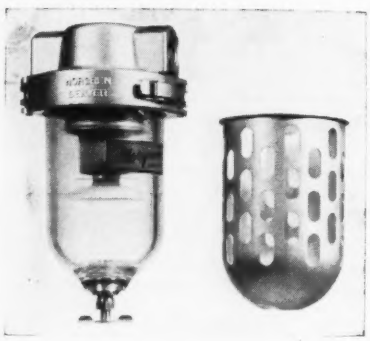
Anderol L-751 is available in 1 pound and 5 pound cans, 14 ounce cartridges and 35 lb., 100 lb., and 400 lb. drums.

For additional information, ordering or samples write to Lehigh Chemical Company, Industrial Lubricants Division, Chestertown, Maryland.

FILTER PROVIDES LIQUID REMOVAL FROM COMPRESSED AIR

The C. A. Norgren Co. has developed and is now marketing a new line of air-line filters, Series 30 BE, that reportedly removes all of the liquid present in compressed air over the full range of air-flow capacity of the air line. Improved baffling is said to make possible this complete removal of liquid.

The company is manufacturing Series 30 BE (transparent bowl) and Series 30 BE-N (metal bowl) air-line filters for use with each of the following pipe sizes: ¼", ⅜", ½".



A choice of 4 optional and interchangeable filter elements for removing the solid particles is available—grit, dust, pipe scale, rust, etc.—from compressed air. The filter elements are easily cleaned and can be used over and over again. The new 30 BE filter is furnished with a 74 micron, 200 mesh, reinforced Monel wire screen unless otherwise specified. For removing smaller particles from compressed air, optional 64 micron, 25 micron or 5 micron sintered metal filter elements are available.

The air passages through the filter have been made larger than the internal area of the pipe, and the area of the openings through the filter element are up to 26 times the internal area of the pipe. As a result, there is a minimum of pressure drop across the filter.

For further information write to the C. A. Norgren Co. 3400 South Elati Street, Englewood, Colo.

LUBRICANT SAMPLE OFFERED

Free samples of Molykote G, a grease consistency lubricant which has proven to be a new production tool for industry, are being offered by The Alpha-Molykote Corporation. Experience in Europe as well as in the United States, has shown that this is the most universally useful of all the 18 standard types produced by the company, which is the manufacturer of molybdenum disulfide lubricants for industry.

The small sample tubes of Molykote G are being mailed to over 20,000 production and maintenance engineers in the metalworking industry, and offered, by direct mail, to over 40,000 others concerned with industrial lubrication. Alpha-Molykote officials believe that the sample will help production and maintenance supervisors discover many useful and beneficial applications for the lubricant.

The lubricant is used throughout industry to eliminate fretting, galling, seizing, and metal pickup in high bearing pressure applications such as heavily loaded gears, cold metal forming, threaded connections and press fitting. It is also proved to be very effective as a wear-in lubricant to reduce wear and shorten run-in periods.

The sample is being accompanied by a four-page, four-color bulletin which describes possible application instructions. Both the sample and Bulletin 126B may be obtained without cost from The Alpha-Molykote Corporation, 65 Harvard Avenue, Stamford, Conn.

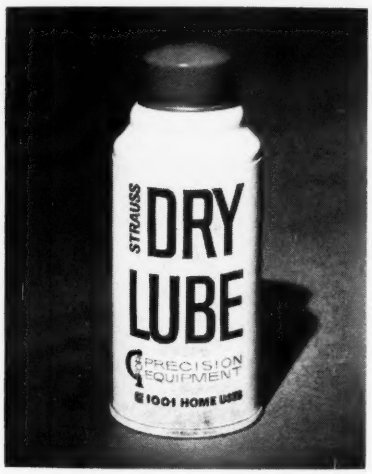
(Con't. on page 199)

NEW PRODUCTS

(*Continued from page 198*)

NEW SPRAY-ON DRY LUBRICANT

Strauss Photo Technical Service, Inc., 930 F Street, N.W., Washington, D. C., announces the market availability of Strauss Dry Lube, a new comprehensive dry lubricant for home, office and plant use.

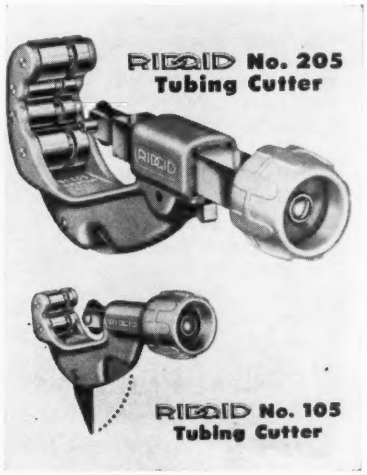


Packaged in an aerosol dispenser, a spray of Dry Lube provides an invisible lubricating and protective film of extreme durability. Utilizing a fluoro-carbon as its active ingredient, greaseless Dry Lube is non-toxic, inert, is said to leave no unsightly stains on delicate finishes and can be buffed to a high gloss.

Dry Lube's imperviousness to weather conditions renders it ideal for both indoor and outdoor uses. A non-conductor of electricity, Dry Lube is highly suitable for lubricating electronic equipment such as relays, switches, rheostats, sockets, dials and solenoids. Dry Lube's clean, non-corrosive, non-rusting, dirt resistant qualities are indicative of its effectiveness in lubricating and protecting such demanding items as photographic equipment, precision tools and instruments, as well as such heterogenous items as drawers and cabinets, conventional and storm windows and doors, zippers, skis, locks and latches, musical instruments and an endless array of other applications.

ENCLOSED FEED TUBING CUTTERS INTRODUCED

Two new RIDGID Tubing Cutters, featuring fully enclosed feed screws that resist jamming with chips or dirt, have just been introduced by The Ridge Tool Company. Called the 105 and 205 Tubing Cutters, they give quick clean cuts of copper, brass, aluminum tubing and thin-wall conduit. Each carries a spare cutter wheel in the handle. A special cutter wheel for the No. 205 only is available for cutting plastic and aluminum pipe.



The Cutters are made of lightweight, high-strength cast aluminum alloy. Grooved rollers give easy flare cut-offs without tubing waste . . . smooth tubing ready for soldering. Fold-in reamer is always handy. Both cutters conform to Federal Specification GGG-C-771b, Type II—Class I—enclosed feed.

The 105 Tubing Cutter has a ⅛" to 1-⅛" O. D. capacity. The 205 Cutter has a ⅛" to 2-⅜" O. D. capacity and, because of this large size range, has instant slide-to-size adjustment—just a slight push on handle snugs the cutter wheel against tubing where it locks until released.

Information on the RIDGID Nos. 105 and 205 Tubing Cutters is available from The Ridge Tool Company, Blyria, Ohio.

EASY LOAD GREASE CARTRIDGE AVAILABLE

A new, easy-loading grease cartridge packed with a multi-purpose lubricant and fitting all cartridge type grease guns is now available from Gulf Oil Corporation, Pittsburgh.

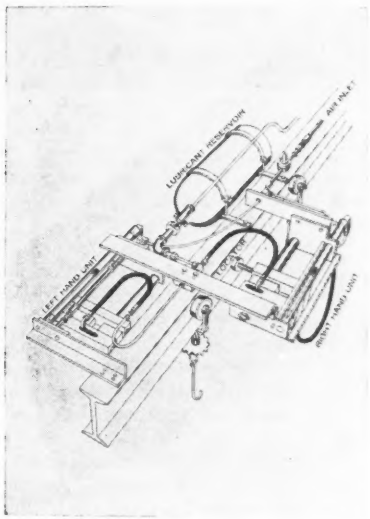
The cartridge offers a quick insert-use-discard method of handling to simplify lubrication and reduce grease loss. Also, special leakproof sealing eliminates any contamination by grime and grit.

The new cartridge is described in a bulletin—SP-9672—available from Gulf Oil Corporation, Department DM, Gulf Building, Pittsburgh 19, Pa.

NEW TROLLEY LUBRICATOR FEATURES FLOOR LEVEL CONTROL

A new, fully automatic, air-powered trolley lubricator which is operated by remote controls from the floor level, is announced by the Aro Equipment Corporation.

The new unit is self-adjusting self-contained. It consists of left and right hand lubricating assembly, a five-pound capacity lubricant reservoir mounted on a four-foot "I" beam, and an electrical or pneumatically operated control panel. It is designed for fast, easy installation in existing trolley conveyors.



A unique fold-a-way mechanism retracts the lubrication unit out of position to prevent damage to the lubricator or trolley conveyor, if trolley wheels in the conveyor system become damaged. In addition, simplified design is said to eliminate cams, levers and springs that become worn and go out of adjustment.

Company officials point out that the lubrication units cannot miss a fitting. They deliver a predetermined, measured amount (up to .025 cubic inches) of lubricant per shot. Lubricant cannot be discharged from the unit unless coupler is properly connected to fitting. This eliminates droppage on work and lost time due to reworking parts.

For further information write to the Aro Equipment Corporation, Bryan, Ohio.

(*Con't. on page 200*)

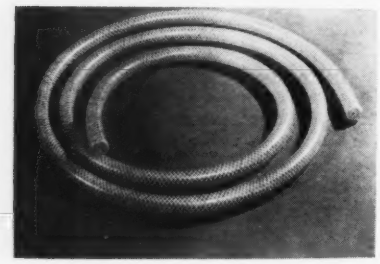
NEW PRODUCTS

(*Continued from page 199*)

NYLON-REINFORCED P.V.C. HOSE WITHSTANDS HIGH PRESSURES

A transparent Polyvinyl chloride (P.V.C.) hose reinforced with open mesh Nylon for high pressures is being distributed by Newage Industries, Inc.

The Nylon, not exposed to either surface, strengthens the hose and is said to withstand pressures up to 1500 p.s.i., yet retains the qualities of standard plastic hose.



It is recommended for factory air lines, pneumatic equipment, fuel pressure lines, oil lines, high pressure machinery, etc.

An opaque grade is offered for aircraft fuel lines and similar applications.

The Nylon braiding enclosed within the wall is protected from abrasion and penetration of oil or dirt. The hose is reported to be resistant to gasoline, sea water, oils, high octane fuels, coal and butane gases and most chemical solutions.

The working temperature ranges from 170°F. to minus 5°F. Bursting pressure of ⅛" ID is 1,500 lbs. p.s.i.; ¼" is 1,200 lbs. p.s.i.; and ½", 800 lbs. p.s.i.

Standard sizes range from ⅛" to 1-¼" ID. Any conventional fittings can be used.

Free sample and literature is available from: Newage Industries, 222 York Road, Jenkintown, Pennsylvania.

TFE-FLUOROCARBON O-RINGS AVAILABLE

Suitable for use in any operating fluid, TFE-fluorocarbon O-rings are available in about 300 standard sizes, in uniform dash-numbering system for O-rings known as ARP-568. In addition to commercial surface finish, O-rings are available in mirror finish.

For information of TFE-Fluorocarbon O-rings, write Chicago Gasket Co., 1271 W. North Ave., Chicago 22.

FITTING FOR SYNTHETIC TUBING

A new steel fitting for nylon and other plastic tubing has been developed by Flodar Corporation of Cleveland, Ohio. The new fitting has been designed to minimize "blow-outs" and pull-outs," a common occurrence on previously available fittings.

Known as the SELF-LOCK type, the new fitting is reported to be well adapted to hydraulic, and pneumatic power systems, lubrication systems, instrumentation, chemical processing and the like. It is available for both thin wall, type "T," nylon tube and heavy wall, type "H" nylon tube.

The fittings can be had in all commercial shapes and sizes and available in steel, brass, aluminum and stainless steel.

Two exclusive features of the new SELF-LOCK fitting are an internal tube support which prevents collapse of the tube wall as the fitting is tightened; and, a precision sleeve with collet fingers which grip the outside of the tube holding it securely in position.

For further information write: Flodar Corporation, 16911 St. Clair Avenue, Cleveland, Ohio.

STAINLESS BLEEDER VALVES ANNOUNCED

A new line of stainless steel bleeder valves which permits visual check of bleeding or purging of hydraulic lines while the pump or system is in operation, has been announced by Fluid Regulators Corporation.

Featuring a 360° rotatable discharge port for directional control of flow, these valves can be used with any high pressure hydraulic system to eliminate fire hazards and afford maximum safety for operating personnel.

For visual check of bleeding or purging, a clear plastic tube may be slipped over the discharge nozzle. This feature eliminates splatter and mess and makes the unit ideal for handling flammable, corrosive and toxic fluids.

The bleeder valves are available with either a knurled knob or slotted bleed screw, making them adaptable for a variety of applications.

Constructed of 303 and 416 stainless steel, the valves have a burst pressure above 14,000 psi and can be used with all compatible fluids. Temperature range is from —65° to + 275°F. Three sizes are available with 5/16-24, 3/8-24 and 7/16-20 UNF mounting threads. Mate with AND 10050-2, -3 and -4 ports. The height above mounting surface for slotted screw unit is 21/32"; the hand knob unit is 27/32". Safety wire holes are provided.

Further information may be obtained by writing Fluid Regulators Inc., 313 Gillette St., Painesville, Ohio.

POXYLUBE 42 OFFERED FOR INDUSTRIAL USE

A new bonded film lubricant called Poxylube 42 has been offered for industrial use by Poly Chem of Indianapolis.

Developed for use in critical military applications where normal oil—base lubricants have proven inadequate, Poxylube 42 is said to have an increasing number of industrial uses because of the elimination of costly surface pre-treatment and because it is permanently effective when dried at room temperature.

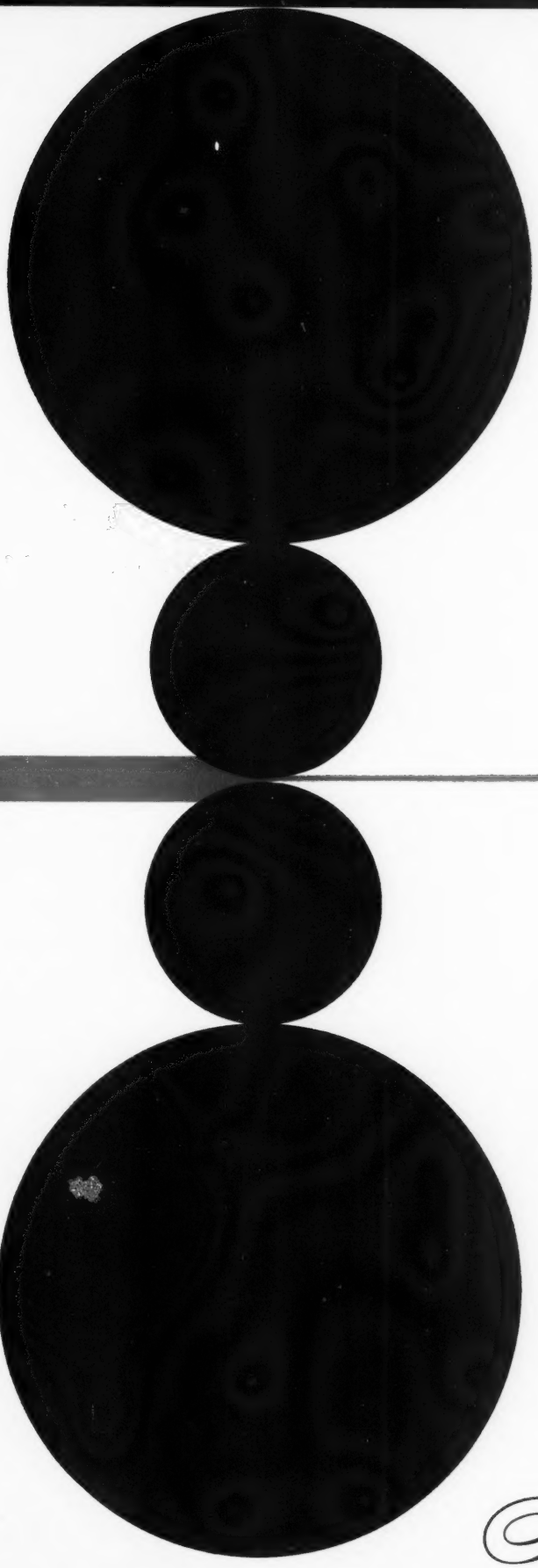
Poxylube 42 is reported to have exceptional lubricating qualities and permanence combined with high resistance to wear and contamination. This lacquer type material is easily applied to metals, glass, or plastics by spraying, dipping, or brushing. Although Poxylube 42 is designed for use without curing, it has been pointed out that its solvent resistance and hardness can be increased by baking at moderate temperatures. It is also reported that the adhesion being greater than the tensile strength assures lubrication even when elongated beyond the yield point, and flexing does not affect adhesion.

The manufacturer states further that Poxylube 42's initial lubricity increases upon use due to the sliding action upon the surface, and because the lubricating film is dry, it will not pick up dust or become gummy.

For additional information, or sample of Poxylube 42, send written letterhead request to Poly Chem, 541 S. Webster Ave., Indianapolis 19, Ind.

OILTIGHT LIMIT SWITCHES OFFERED

Designed for high-speed, precision production machines, oiltight limit switches are sealed to check seepage of oil, coolants, moisture, and abrasive grit. External seals are located at operating shaft bearing and between cover plate and contact assembly. Internal seal between operating head and switch base is additional protection. Contacts are enclosed, but visible. Switches, for surface and flush mounting, are calibrated to control tolerances, producing identical operation of all switches. Further flexibility is offered by 14 different operating heads, which can be mounted in any of four positions. Rotary levers can be positioned anywhere through 360° circle. For more information write: Cutler-Hammer, 296 N. 12th St., Milwaukee, Wisc.



High production, key to steel prosperity, rolls on lubricants. Ironsides can help you lick its new problems.

Ironsides

SHIELD PRODUCTS

For tailor-made roll oils, address The Ironsides Company, Columbus 16, Ohio, Makers of Palmoshield

LABORATORY REPORT

Testing proves Baragel* and Baragel* 24 grease effectiveness

BARAGEL grease tests being conducted continuously

Tests are constantly being conducted using BARAGEL and BARAGEL 24 in greases made from both petroleum and non-petroleum base oils. The greases are formulated from refined oils of varying viscosities with selected dispersion aids.

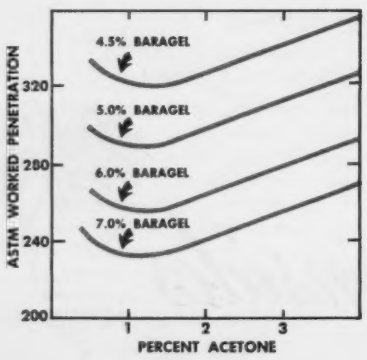
BARAGEL and BARAGEL 24 are versatile, non-soap grease gelling agents consisting of mixed organic ammonium halides and refined sodium montmorillonite. Test results are available in printed form. If you are not already on the mailing list, you can obtain Data Sheets by writing Baroid Chemicals, Inc.

BARAGEL very versatile in greases made with oils of varying viscosity indexes

BARAGEL is considerably more efficient than BENTONE* 34 in greases compounded with solvent refined, high VI oils. Greases having an ASTM worked penetration in the 315 range require about 4.5% BARAGEL compared to a BENTONE 34 requirement of about 5.75%.

BARAGEL has also proved to be efficient in greases compounded with conventionally refined oils of relatively low viscosity index. Tests were made with a base oil of 21.5° API gravity and a viscosity of 517 SUS at 100° F.

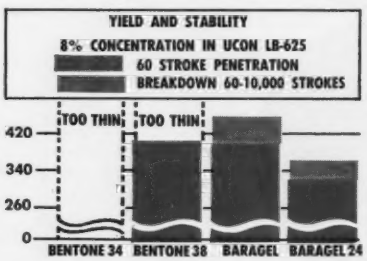
BARAGEL was stirred into the oil, acetone added and stirred, and the mixture was milled. Greases having an ASTM worked penetration in the 315 range required about 4.5% BARAGEL, while greases in the 280 range required about 5.5% BARAGEL. Data Sheet A-3, available on request, gives full details of this test.



Greases made with Ucon LB-625

BARAGEL 24 is more efficient in thickening Ucon LB-625 than are BENTONE 34, BENTONE* 38 and BARAGEL. BARAGEL 24 greases are also more stable to working in the ASTM grease worker.

In a series of tests, the gelling agents were stirred into the Ucon LB-625, propylene carbonate was added, heat applied, and the mixture was milled. The chart above compares the results of thickening greases with BENTONE 34, BENTONE 38, BARAGEL and BARAGEL 24. Full details of these tests are available in Data Sheet A-1.

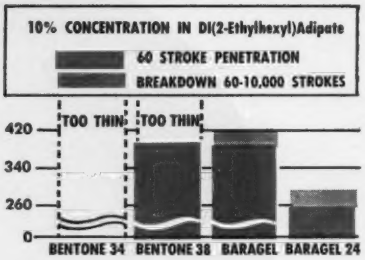


The worked penetration of a grease made from Ucon LB-625 and 8% BARAGEL 24 was 315, with a penetration of 355 after working 10,000 strokes.

BARAGEL 24 efficient in greases made with Di(2-Ethylhexyl) Adipate

BARAGEL 24 has been proved by tests to be particularly efficient in thickening greases made with Di(2-Ethylhexyl) Adipate. Greases prepared with BARAGEL 24 are also much more stable to working in the ASTM grease worker.

Tests were made to compare results when thickening greases with BENTONE 34, BENTONE 38, BARAGEL and BARAGEL 24. The results are shown in the accompanying chart and



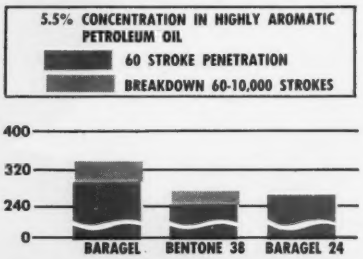
details are available in Data Sheet A-2.

Greases made with Di(2-Ethylhexyl) Adipate and 10% BARAGEL 24 showed worked penetrations of 260. After working 10,000 strokes, these same greases showed a penetration of only 290.

BARAGEL 24 in grease made with petroleum oil

In a particular petroleum oil of high aromatic content (28%), BARAGEL 24 produces a grease completely stable to working in the ASTM grease worker over the range of unworked to 10,000 strokes.

In a series of tests, the oil used had an API gravity of 16.9° at 60° F and a viscosity of 309 SUS at 100° F. The worked penetration was 265 when 5.5% BARAGEL 24 was used. Comparisons of penetration when using the same per cent of BENTONE 34 and BARAGEL are shown on the accompanying chart. Full details are available in Data Sheet A-4.



BAROID

BAROID CHEMICALS, INC.

A SUBSIDIARY OF NATIONAL LEAD COMPANY
1909 SOUTH COAST BUILDING
HOUSTON 2, TEXAS

*Trademark of National Lead Company for an organic ammonium montmorillonite.

2033

PRODUCT LITERATURE

DATA AVAILABLE ON ALUMINUM BEARINGS

. . . A new booklet, "Alcoa Bearings," is offered to industry.

The concise title is borne by Aluminum Company of America's latest and most extensive collection of case histories, engineering, and test data pertaining to sleeve bearings and bushings of the light metal.

According to the 90-page study, aluminum has been fashioned into bushings (single piece hollow cylinders) ranging in size from pieces no larger than a fingertip—to gigantic 4-foot diameter units weighing ¾ ton, and built to support loads of more than 5-million pounds. The art and science of designing these particular parts—and the majority which fall between these dimensional extremes—is discussed fully in the booklet.

Ten case histories, detailing both common and exceptional applications, preface two large sections of engineering and test data. The latter presentations aid designers in specifying aluminum bearings (two half shells, or several segments) and bushings in many areas once considered not feasible for the bright metal.

Liberal use of charts, graphs, drawings, and photographs in the technical discussion aid the designer by presenting data gained from Alcoa's extensive experience with light metal bearings and bushings.

Further information may be obtained from Alcoa sales offices, or by writing Room 732, Alcoa Building, Pittsburgh 19, Pa.

CATALOG OFFERED TO FLUID POWER USERS

Users of fluid power equipment will find a wealth of valuable data and other pertinent information in the new Anchor Distributor Catalog D-1. This new catalog presents a complete line of "Reusable Hydraulic Couplings, Hose and Fittings" . . . together with application data, specifications, engineering recommendations and methods of computing length of hose assemblies.

Of particular interest to fluid power users are the step-by-step photographic instructions for assembling various types of Anchor Couplings to hose. Product information covers: Reusable Couplings, Hose, Adapters, Grease Hose Assemblies and Anchor Hydraulic Hose Assemblies of all types.

Copies of Catalog No. D-1—Anchor "Reusable Hydraulic Couplings, Hose and Fittings"—are available, at no cost, from Anchor distributors, or by writing direct to Anchor Coupling Co. Inc., Libertyville, Illinois.

FILTER BULLETIN REVISED

An eight-page bulletin on multiple-surface porous stainless steel filters is available free from Micro Metallic Division of Pall Corporation, Glen Cove, N. Y. The newly revised literature includes information on porous stainless steel filters which can meet a wide range of flow rates, temperatures, pressures and slurries. Several new filter types and sizes are described.

Typical filter aid set-ups are described. Full information is given on engineering data on porous stainless steel, including method of manufacture, particle size removal, flow rates, working and welding. A description of RIGIMESH, a furnace welded woven wire mesh, includes characteristics which make it suitable for specialized applications.

SECTION NEWS

Baltimore. . . . A. B. Wilder, president of ASLE last year, was guest speaker at the regular March meeting. Mr. Wilder began his talk by discussing the national organization and the activities of ASLE. His subsequent talk covered "Trends in Lubrication" which was concerned with the limited application of some lubricants and what is being done to extend the boundaries of lubrication requirements in special fields. . . . **Boston**. . . . Attendees of the course in "Practical Lubrication" sponsored by the section, were guests at the March Meeting. Allen F. Brewer, consulting editor of LUBRICATION ENGINEERING, gave a talk entitled "What Price Lubrication" which was very well received by the group. The regular monthly feature recently instituted "What's Your Problem" followed Mr. Brewer's talk. Problems facing the members were discussed by the entire group. . . . **Chicago**. . . . The March meeting featured a special corned beef and cabbage dinner in honor of St. Patrick's day. "Precision Gearing and its Lubrication" was the subject of a talk by H. O. Kron of the Philadelphia Gear Corporation. The talk dealt with types of gearing accuracies, system of classifying gearing and reasons for selecting gears of a particular precision. Mr. Kron also discussed the lubrication requirements of precision ground gearing. . . . **Duluth-Iron Range**. . . . Guest speaker at the regular March meeting was L. O. Witzenburg of the Cleveland Worm and Gear Co. His talk was on the subject of "Lubrication of Worm Gears." Other guests included A. B. Wilder, ASLE president; B. T. Harding, National ASLE director; and R. O. Erickson, Midwestern Regional area representative. . . . **Hudson-Mohawk**. . . . R. E. Lee, Bearing Materials Engineer, General Electric Co., spoke on "Sleeve Bearing Materials" at the regular monthly meeting. He discussed types of bearing wear, effect of operating conditions on performance, and sleeve bearing materials. . . . **Milwaukee**. . . . A slide lecture entitled "Modern Methods of Lubricant Application" was presented by E. J. Gesdorf of the Farval Division of Eaton Mfg. Co. The lecture traced the history of centralized lubrication, basic design principles, principles of system operation, control of components, and types of systems. . . . **Montreal**. . . . A plant tour and supper was the change of pace scheduled for the April 6 meeting of the Montreal Section. Members and guests were conducted on a tour of the Dominion Engineering Company limited manufacturing plant. . . . **New York**. . . . "Criteria for Selection of Cutting Oils in the Plant" was the subject of a talk by C. Brown of the Shell Oil Company. He pointed out definite methods for selecting the correct cutting fluids for specific machining jobs. He also covered machinability of metals, tooling, and properties of coolants. The meeting was held at the Essex House in Newark, N. J. . . . **Pittsburgh**. . . . The regularly scheduled March meeting was held at the Royal York Dining Room and was designated "Bosses Night." Guest speaker for the evening was C. L. Pope, Chief Lubrication Engineer for Eastman Kodak Co. who described the lubrication program at Kodak Park, and illustrated his remarks with color slides showing his plants and the equipment involved in this extensive program. His remarks were followed by an enthusiastic question and answer period. . . . **Toronto**. . . . The technical session of the March meeting centered around E. W. Fisher, Garlock Packing Company, who was guest speaker. His subject was entitled "Lubrication and Maintenance of Seals and Packings" and covered a subject about which Mr. Fisher is well qualified to discuss. . . . **Twin Cities**. . . . L. O. Witzenburg was invited speaker at the March 31st meeting. Mr. Witzenburg of the Cleveland Worm and Gear Company is ASLE National president-elect. His talk was on the subject of problems and solutions to lubrication of worm gears.

SITUATION AVAILABLE

Major oil company wants experienced Industrial Lubricant Sales Engineer to develop Texas and Louisiana Gulf Coast business.

Address resume' experience and accomplishments to Box LE—5, Lubrication Engineering.

INDUSTRY NOTES

(*Con't. from page 197*)

Catalin Corporation of America, Ford, N. J., has announced the completion of its expansion of facilities to produce antioxidants.

Aid in publishing articles is given to professional employees by the Reaction Motors Division of Thiokol Chemical Corp., Denville, N. J. A special committee has been set up as a "literary agent" to evaluate abstracts of proposed articles and to submit them for acceptance to the proper societies or publications. If the abstracts are accepted, the professional employee prepares a finished copy which is again reviewed by the committee and submitted for publication. Of 70 papers acted upon to date, 23 have been published.

A technical reading course in Russian is sponsored by the employee relations department of the Esso Research and Engineering Company, Linden, New Jersey and Florham Park, New Jersey. The 200 hour course is attended by 25 employees of the company and is taught by a Rutgers University professor.

PERSONALS

(*Con't. from page 197*)

Edgar B. Smiley has joined Brad Foote Gear Works, Inc., as sales manager. He formerly was a vice president and sales manager for Illinois Gear and Machine Co. The appointment of Robert J. Byerwalter as executive engineer for the gear manufacturing firm has been announced. He succeeds William F. Plume who recently resigned.

LETTERS TO THE EDITOR

Lubrication Engineering welcomes the comments and suggestions of readers with regard to articles published in its pages or concerning topics of interest to those engaged in any phase of lubrication engineering. Letters received cannot be acknowledged, but those felt to be of interest to other readers will be published. The Society will not be responsible for the statements or opinions expressed.

Sir:

This letter is intended to ask your help in providing our library with your famous periodical, *Lubrication Engineering*. Our members, who are mostly of the University's Technical Department, will be very proud if they could enlarge their knowledge by reading your magazines, which are world known for their quality. Because of our financial difficulties, it is almost impossible for us to buy good technical books and magazines such as your editions because they are very expensive nowadays in Indonesia.
If it does not bother you, will you be so kind as to help us enlarge our collection of books and magazines. We will be very glad and very thankful to you if this could happen.
Should you need some information about Indonesia or our organization, we will be ready and glad to answer you.
Thanking you in advance for your kindness and attention, we remain,

Sincerely yours,

H. Gan Joe Kang
Director I Library Section
Union of University Student
Republic of Indonesia

Editor's note: Director Kang will be the recipient of *Lubrication Engineering* on a regular basis in the very near future.

Sir:

Congratulations on the editorial "To Know Ourselves" in the March issue of LUBRICATION ENGINEERING—it was timely and pertinent.
Your remarks concerning the forthcoming series of reports entitled, "The Lubrication Engineer in Action" to be published in the "Journal" is something that has been close to my heart for a very long time. You will note on page 3 of the agenda for the Annual Short Course in Lubrication Engineering, to be held during the Annual Meeting in Cincinnati, all of the lectures on Wednesday and Thursday are entitled, "A Lubrication Engineer Looks at——— Problems."
Again, congratulations.

Sincerely,

M. E. Dougherty, Chairman
ASLE Education Committee

Sir:

Please advise if selected prints (single copies) of papers of the ASLE can be supplied to the Mechanical Engineering Department of the University of Virginia. We give an eight weeks course in Lubrication to our seniors in Machine Design and I believe that these papers would be put to good usage. Our seniors also write senior English thesis papers on such subjects and these papers would serve a purpose there too.
I believe that I can put these to much better use than in most any other way and I feel that the entire study of Lubrication is so badly neglected in our engineering design studies.

Sincerely yours,

Gaston G. Fornes
Professor of Mechanical Engineering
University of Virginia

Sir:

We have read with considerable interest the article dealing with "Two Cycle Gas Engine Lubrication" published in the November, 1959 issue of LUBRICATION ENGINEERING.
This article is of special interest to us and will be used in teaching a course in Engine Maintenance, which is sponsored by the United States Power Squadron, a non-profit organization, which holds free classes throughout the country to develop and foster safe boating.
Congratulations on publishing this timely article. May we have reprints for our students?

Sincerely,

Oscar Olsen
Watchung Power Squadron
New Jersey

Vol. 16, No. 5

Lubrication Engineering

. . . liaison representatives

The purpose of ASLE, as set forth in our constitution, is "to promote the advancement of the knowledge and application of the science of lubrication and related arts and sciences." One of the principal ways in which ASLE accomplishes its purpose is by the distribution of information on the science of lubrication to our members. Lubrication encompasses a broad field of interest and is therefore involved in the work of many different engineering and scientific societies. ASLE must work in close cooperation with all of these other organizations. Liaison between technical and scientific organizations has always been difficult. With the increasing scope of activity in the field of lubrication the problem of contact with others is becoming more difficult each year. In an attempt to improve our communication with others, the Board of Directors has recently adopted a new Liaison policy. In essence, this new policy places the responsibility for keeping the Society informed of activities of other engineering and scientific societies upon the Technical Committees and Industry Councils. Members of the Technical Committees and Industry Councils are being urged to advise their Chairmen of any outside activities that would be of interest to the ASLE membership. We should like to take this opportunity to invite any ASLE member not directly associated with an Industry Council or Technical Committee to advise "Lubrication Engineering" of any such activities that come to their attention. In the past, the Society has appointed Liaison Representatives in an attempt to maintain contacts with other organizations. Because of the growth of the lubrication science it appears, however, that this approach imposes too great a burden for one individual to carry. Under the new system, it may still be necessary, at the discretion of the President of the Society, to appoint an official ASLE Liaison Representative to another society for the purpose of promoting cooperation in a *specific instance*. The Liaison Representative will act as an official spokesman for ASLE in projects or activities involving other societies. Those who have served the Society in the past in liaison capacities have served well. The Board of Directors hopes that the new system will eventually provide closer cooperation with other societies without overburdening any individual ASLE member.

L. O. Witzenburg
President

Part 3- Compendium of Lubricating Devices

by Allen F. Brewer*
Consulting Editor

Illustrated by Robert R. Wayne
Pittsburgh, Pa.

In this section the main features of various lubricating devices will be given. For space reasons it is of course impossible to include every device or all the modifications of a particular device. It is felt however that the lubricators chosen are typical of those more generally encountered in service.

The illustrations have been kept quite schematic to stress the principles of operation rather than details of construction. The descriptions are not intended to permit one to design or build a particular lubricator, but rather to provide an overall familiarity with the types of devices available for lubrication.

Fig. 1. Oil Can

*Consultant and Author "Basic Lubrication Practice."

Oil Squirt Cans

There are a variety of squirt cans available. One of the most familiar is shown in Fig. 1 and is a type often found in the home.

Fig. 2 shows a more refined pump-type squirt can that has the advantage that a fixed quantity of oil is delivered each time the actuating rod is depressed.

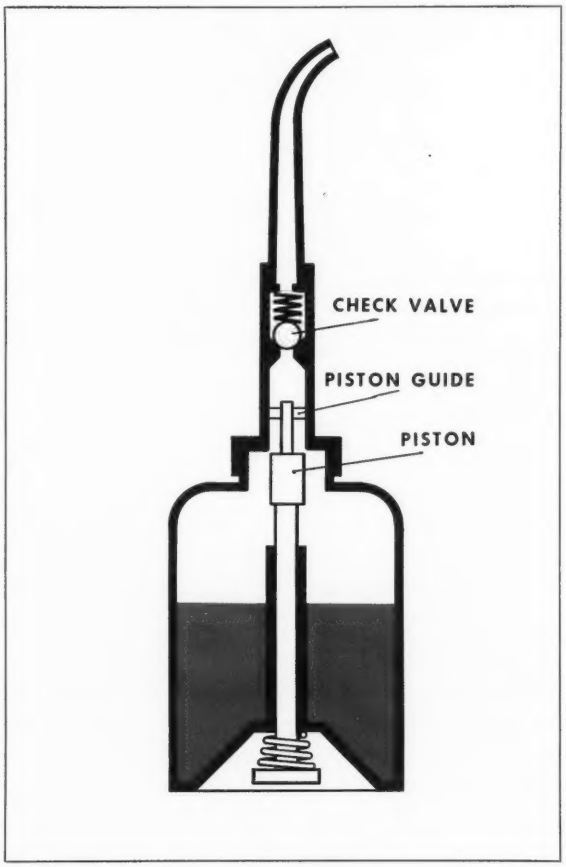


Fig. 2. Pump-Type Oil Can

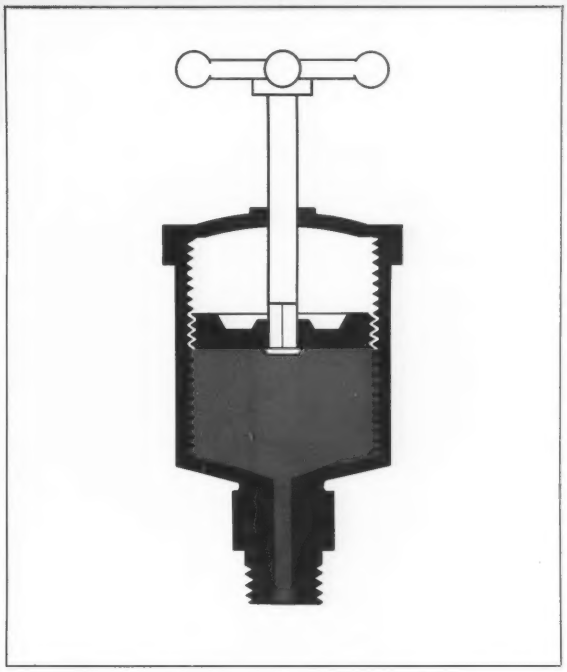


Fig. 3. Screw-Type Grease Cup

Screw-Type Grease Cup

A manual device for dipersing soft lubricating grease is the screw-type grease cup shown in Fig. 3. The height of the handle above the cup serves to indicate the amount of lubricant left in the cup. Some grease cups are built with a spring loaded piston that permits the grease to feed without requiring the presence of an operator.

Grease Gun

There are a great variety of grease guns that differ in size and dispensing pressure. A typical lever-type grease gun is shown in Fig. 4.

Turning handle A causes the spring loaded plunger B to move grease through port C to the lever-operated pump whose plunger traveling in the high pressure chamber D forces the grease past the ball valve E to the coupling and fitting.

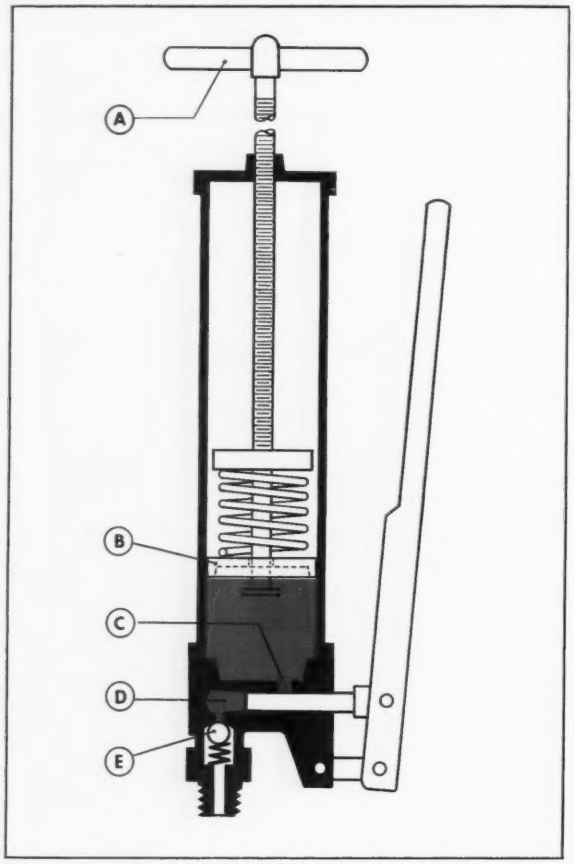


Fig. 4. Grease Gun

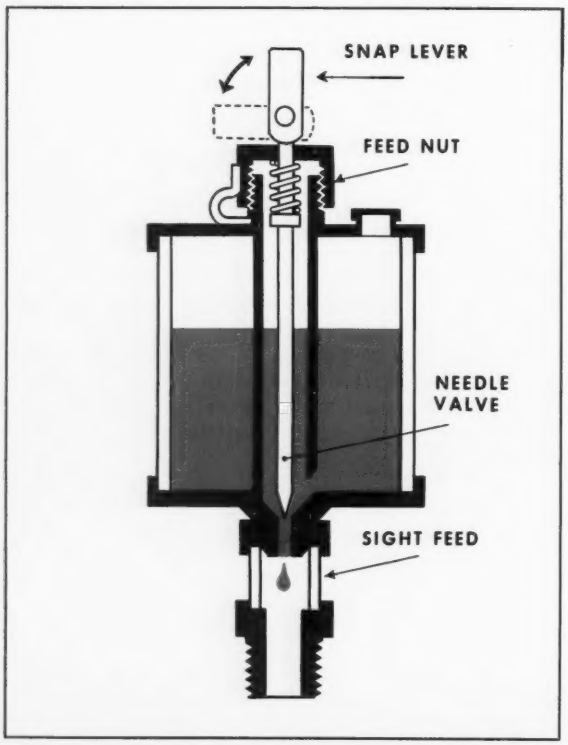


Fig. 5. Drop Feed Oiler

Drop Feed Oiler

A typical drop feed oiler is shown in Fig. 5. Oil flow rate is controlled by a needle valve. A snap lever at the top of the reservoir permits the feed to be manually stopped and started without changing the flow adjustment. The dropwise flow may be observed through a transparent sight feed window. The flow rate is not strictly uniform as it varies as the oil level falls in the reservoir. An operator is required to start and stop the device.

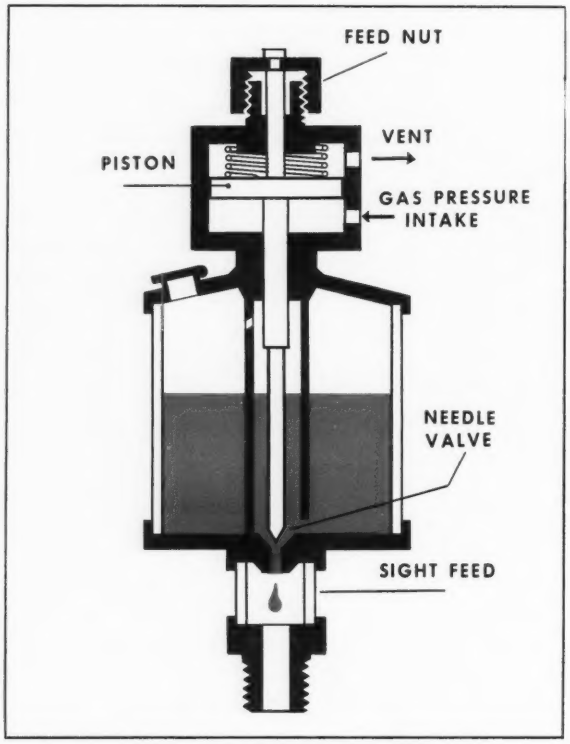


Fig. 6. Pressure Actuated Drop Feed Oiler

Automatic Drop Feed Oiler—Pressure Actuated

In some cases drop feed oilers can be made to operate so that oil flow starts and stops with the machine. Fig. 6 shows a lubricator designed for use on a machine such as a rotary compressor, where gas pressure is available. The lubricator has a needle valve which seats at the bottom of the oil reservoir. The valve stem extends through the operating cylinder mounted on top of the reservoir. The valve is opened and closed by pressure from the compressor discharge exerted against a spring loaded piston. The needle valve is adjusted and the rate of feed is controlled by the feed nut at the top of the steam.

The feed nut can also be used to open the needle valve manually when the compressor is first started and no pressure is available.

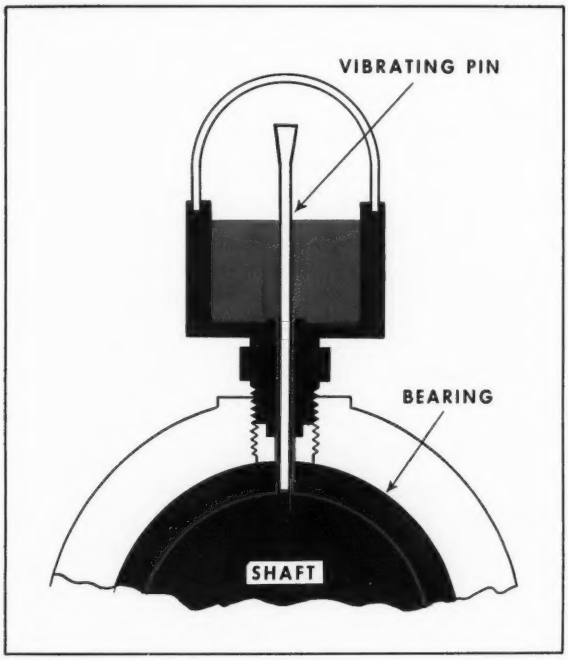


Fig. 7. Vibrating Pin Bottle Oiler

Vibrating Pin Bottle Oiler

In the typical oiler shown in Fig. 7 a vibrating pin or rod which rides on the shaft induces oil feed by developing a very slight degree of vertical up and down motion which produces enough pumping action to cause oil to flow down the rod or pin to the bearing.

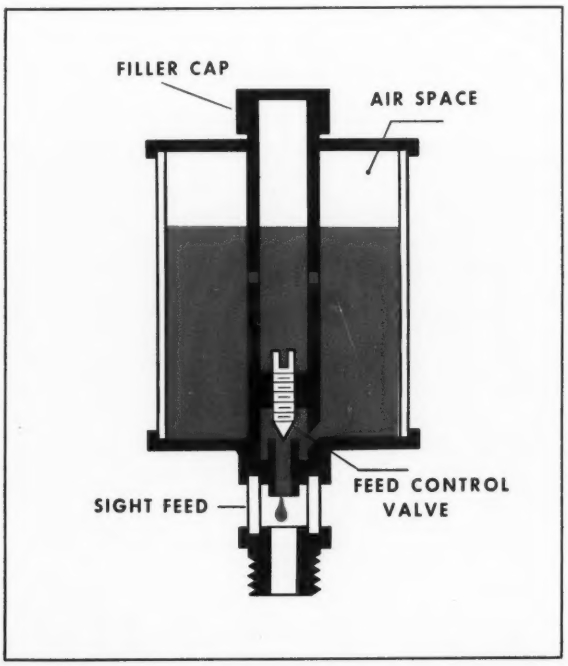


Fig. 8. Thermal Oiler

Thermal Oiler

The thermal oiler shown in Fig. 8 is controlled by variations in the temperature of the bearing. A temperature change in the bearing is transmitted through the metallic parts of the lubricator to the air space above the oil reservoir expanding or contracting the air. Expansion of the air is accompanied by an increase in pressure which forces a small quantity of oil out of the lubricator. When the temperature decreases the air pressure decreases and oil flow ceases. This cycle is continually repeated. There is a time lag between the starting of a machine and the commencement of lubricant flow that may not be tolerable in some applications.

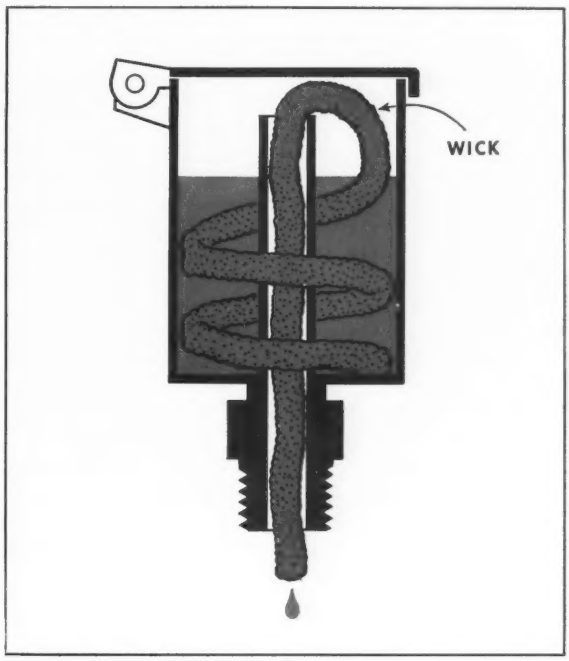


Fig. 9. Wick Feed Oiler

Wick Feed Oiler

The typical wick feed oiler shown in Fig. 9 makes use of the capillarity and siphonic action of the strands of a wick to convey oil from the cup or reservoir to the bearing. The cup may be made of reinforced plastic to permit the oil level to be visible. The rate of oil feed can be controlled by varying the number of strands in the wick and the length to which it extends down into the tube below the level of the oil in the cup.

This article will be continued in next month's issue.

Laboratory tests have revealed that the "drop counting" and "turns" methods of adjusting force feed lubricators are very inaccurate, and that the vacuum type pumps present operating difficulties. Many of the lubrication problems of gas engines may be attributed to this inconsistency of lubrication rates. Also investigated were the effects of high oil temperature, pressure delivered against, and "O" ring correction of slippage.

A stroke measuring method has been devised which permits a more accurate control, and which helps to develop lubrication consciousness. The field modification program far exceeded expectations in substantial lubrication and maintenance economies.

Modification of Force Feed Lubricators

Robert L. Churchwell and Frank J. Kokas
Tennessee Gas Pipeline Company

Presented before the 14th ASLE Annual Meeting, Buffalo, New York, April, 1959.

Who's to say if a gas engine is receiving the correct forced feed lubrication? Management can only observe that installations under apparently identical operating conditions have wide variation in their oil consumption. The master mechanic can only give an answer too late when he observes the damage which has resulted from improper lubrication. The engine designer has also felt this doubt, and the result over the years has been the constant changing of the number and the location of cylinder lubrication points. In general, the burden has been placed in the hands of the operator. He, in turn, has had to depend on the visual indication of the lubricator pump sight feed and on the total amount of oil added to the reservoir in a given period of time. Before such questions as oil quantity, quality, or number and location of lubrication points can be anwsered, the delivery to each lubrication point must be known accurately.

REQUEST

The author's company became concerned over the wide variation in oil consumption on similar engines in similar locations, and initiated a program to study the problem. Field attack was not considered feasible until the component parts of the lubricating system has been tested. Consequently, lubricator reservoirs complete with pumps were transferred from field service to the laboratory for testing in order that field equipment and conditions could be more nearly simulated.

TEST APPARATUS AND PROCEDURE

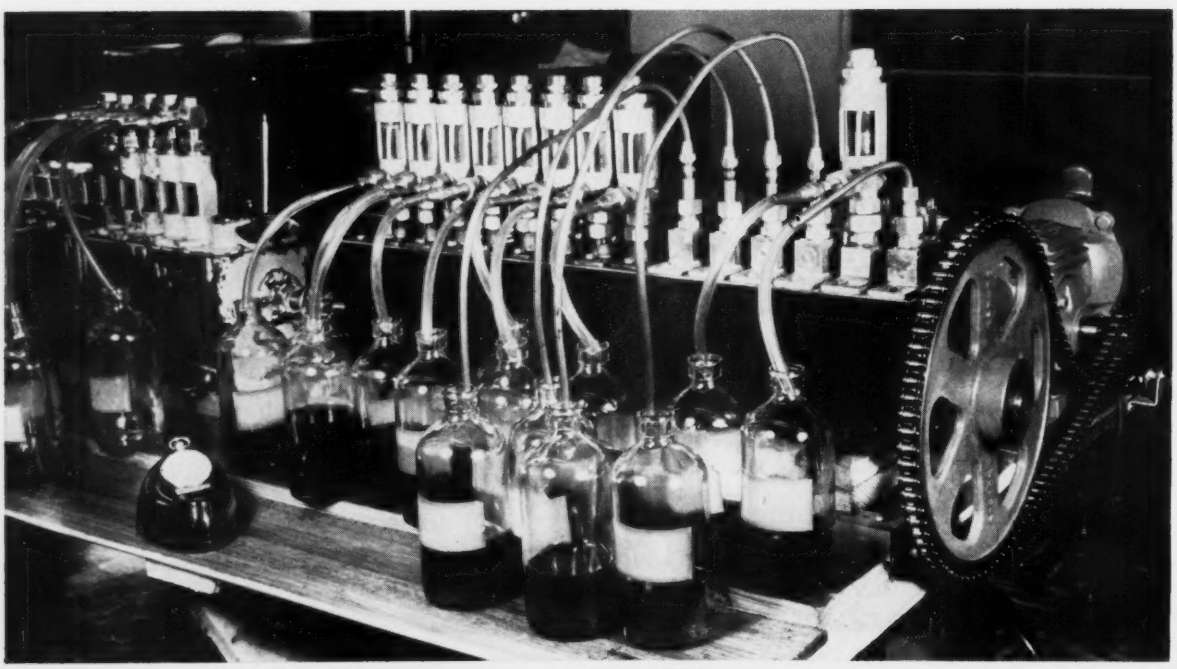
The lubricator pumps were mounted in standard reservoirs with a common drive shaft, which was chain driven with a constant speed motor through a gear reduction box. Thus, all pumps of the test apparatus (Fig. 1) were known to be operating at the same known rpm.

After all lubricators under test had been set to the same delivery rate, the driving motor was then started and the output of each pump was collected in a weighed glass bottle. A subsantial amount of oil sample was collected, and the bottles were again weighed. The gravity of the oil was determined at the operating temperature, and calculations were made to convert from the weight delivered to quarts per day.

DROPS METHOD FOR SETTING LUBRICATOR

When is a drop a drop? A yardman, upon observing a lubricator in operation, once said, "I'se seen lots of drops drop down, but this is the first time I'se seen

Fig. 1. Test Apparatus.



drops drop up." The most popular field method for adjusting the delivery of an individual lubricator is the so-called "drop-counting method." The drops of oil rising through the sight glass are adjusted in accordance with the oil to be delivered to the point of lubrication.

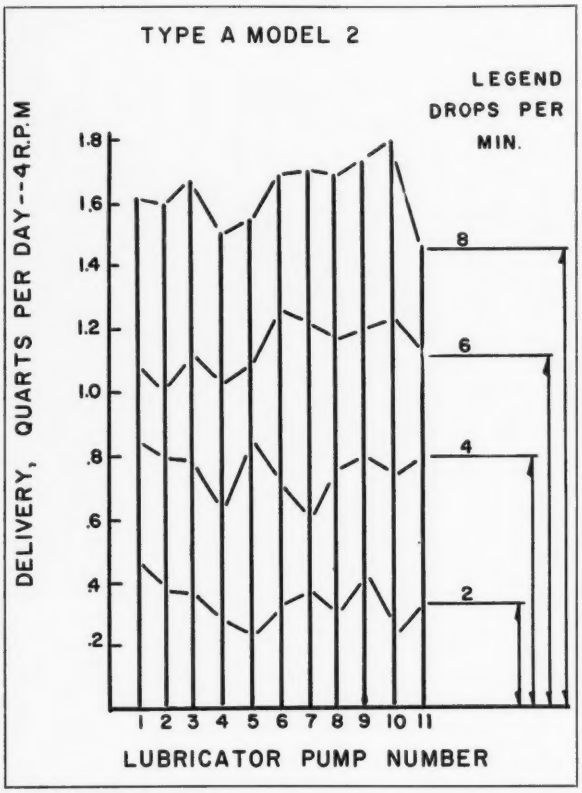


Fig. 2. Type A, Model 2 Deliveries—"Drops" Method.

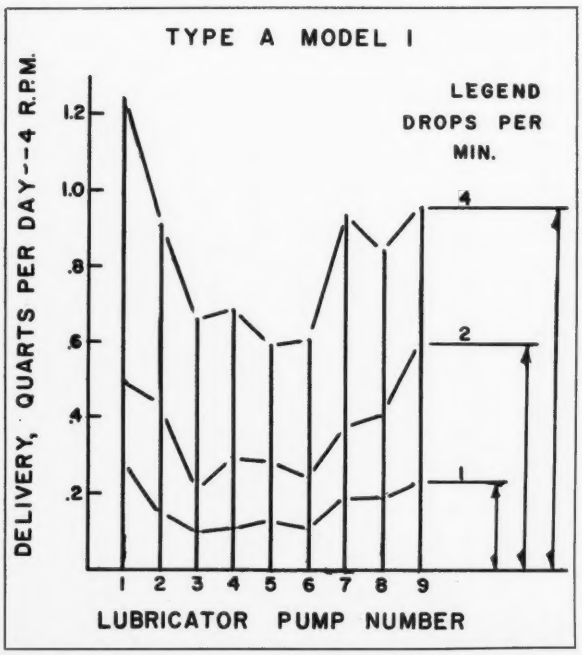


Fig. 3. Type A, Model 1 Deliveries—"Drops" Method.

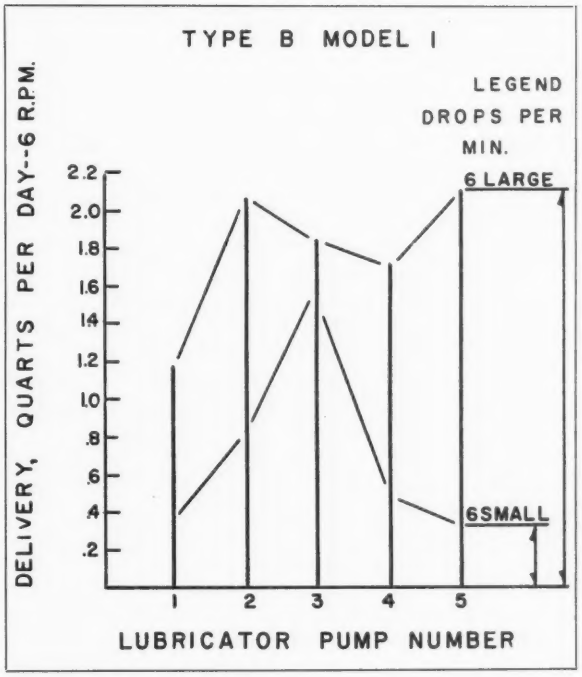


Fig. 4. Type B, Model 1 Deliveries—"Drops" Method.

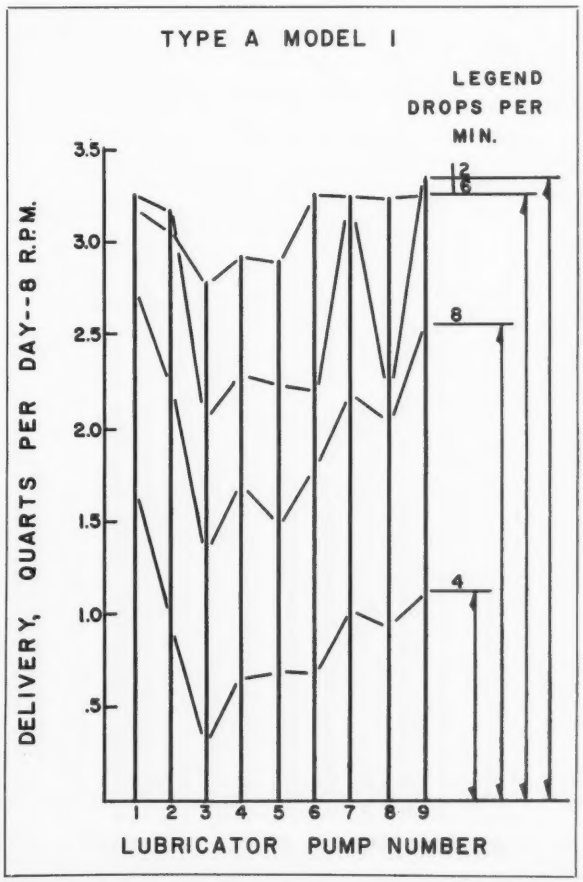


Fig. 5. Type A, Model 1 Deliveries—"Drops" Method.

The initial tests were made, using the drop-counting method for adjustment of the lubricator delivery rates at 4, 6, and 8 rpm, and the delivery rate was varied from a minimum of one drop to a maximum of 42 drops per minute. The pumps tested included the Type A, Models 1, 2, and 3 and the Type B, Models 1 and 2. These force feed lubricators all have a submerged suction. The Type A incorporates a check valve to check valve operation whereas Type B works on a port to check valve operation. The Type A differs in operation from Type B in the cam and rocker arm operation. The Type B cam and rocker arm operation imparts a snap action to the pump plunger. The Type A is shown in Fig. 11.

Typical results of these tests, using the drop-counting method, are shown in Fig. 2, 3, 4, and 5. The delivery rate per pump was very inconsistent, the output varying by as much as 70%. Furthermore, equal changes in drops per minute did not cause equal changes in pump output, nor was the variation of a pump consistently higher or lower than the average. In a few pumps an increase in drops per minute actually resulted in a reduced output. The delivery range of 0.4 to 2.2 quarts per day of one model extended only from six small drops through six large drops.

As a further check, a number of pumps were adjusted to the same drop setting, operated for a period of time, and their outputs recorded. The pumps were then deliberately thrown off this setting and on the next day each pump was readjusted to the rate used on the previous day. Of the eleven pumps tested, none had the same output on the rerun as indicated by Fig. 6.

"TURNS" METHOD FOR SETTING LUBRICATOR

Another popular field method for adjusting the

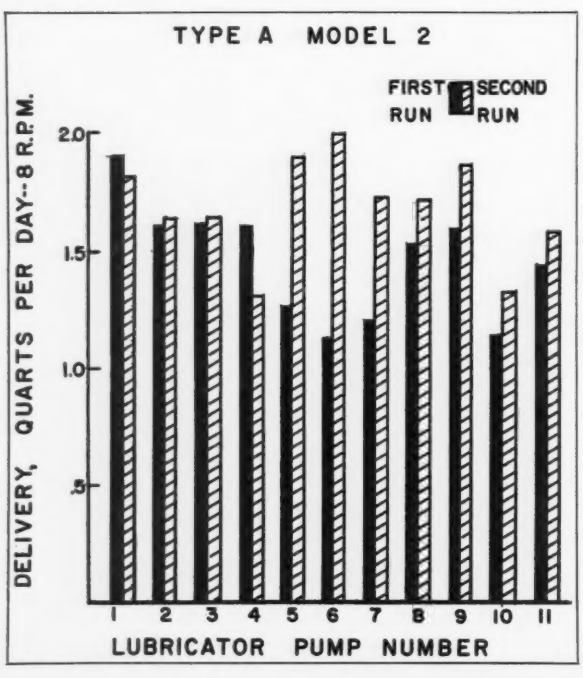


Fig. 6. Type A, Model 2 Deliveries—Reproducibility.

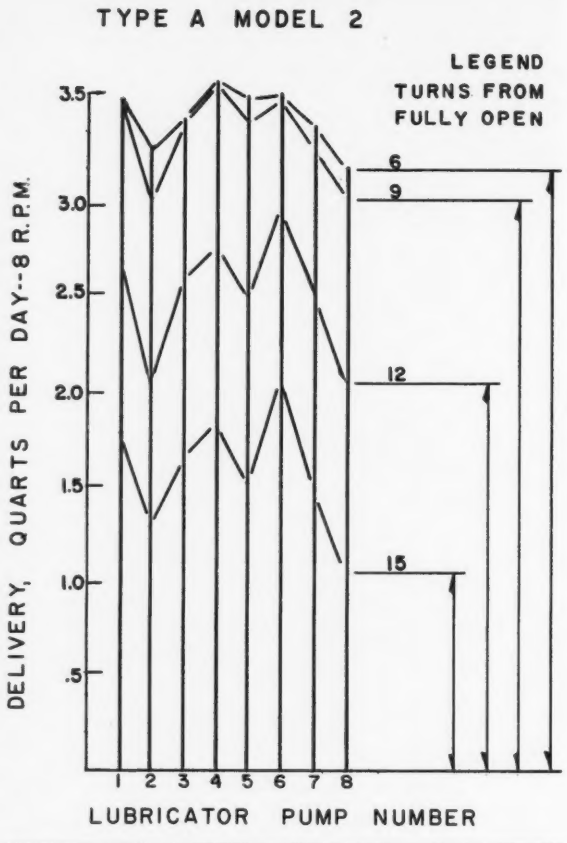


Fig. 7. Type A, Model 2 Deliveries—"Turns" Method.

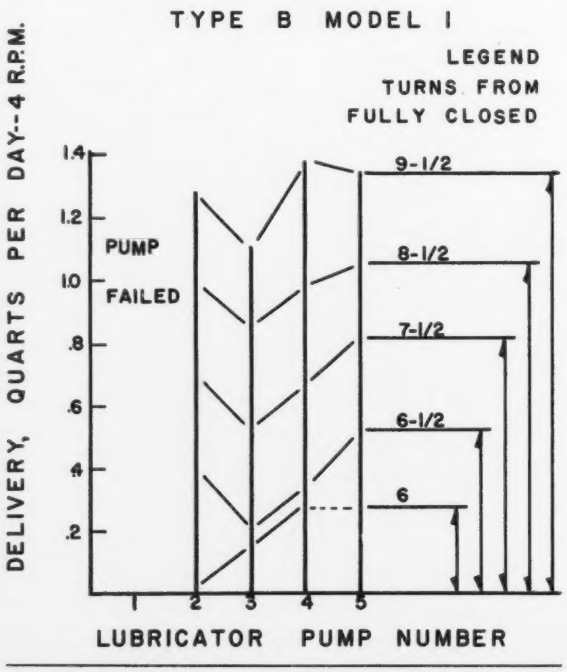


Fig. 8. Type B, Model 1 Deliveries—"Turns" Method.

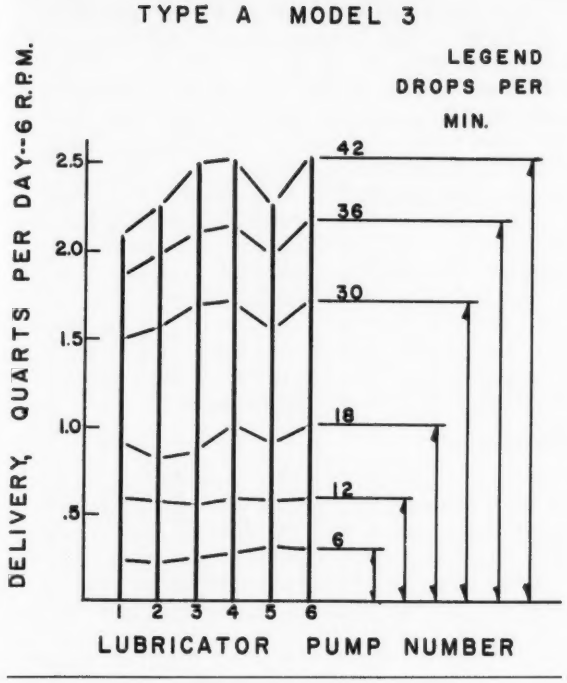


Fig. 9. Type A, Model 3 Deliveries—"Drops" Method.

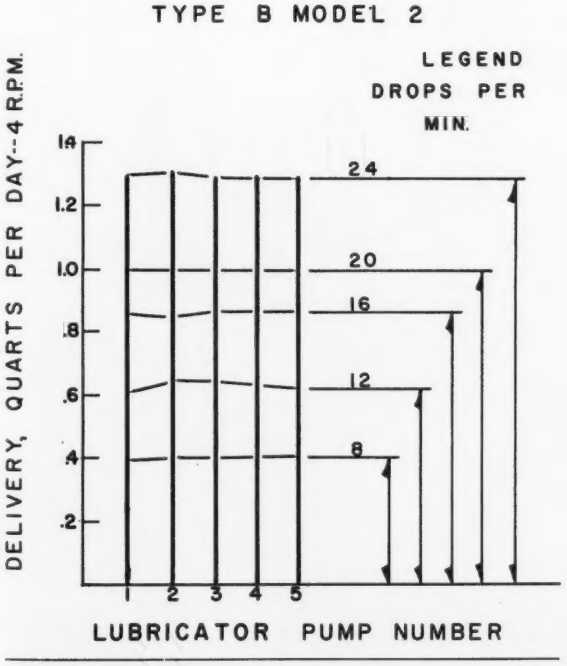


Fig. 10. Type B, Model 1 Deliveries—"Drops" Method.

output of a lubricator is the so-called "turns or flats" method. Incremental changes are obtained by turning the adjusting screw a certain number of complete revolutions or flats from fully open or fully closed. Tests were made at 4 and 8 rpm, and typical results are shown in Figs. 7 and 8.

Initial delivery rates on all pumps were found to be even more inconsistent than with the drop counting method. In fact, the outputs showed as much as twofold variation. Such results were anticipated when it was noted that none of the pumps commenced delivering at the same number of turns. There are ten complete turns of the Type B setting device, and at least six turns from fully closed were required before delivery was obtained. All Type A lubricators had to be set six turns from fully open before a decrease in pump output was noted.

VACUUM PUMPS

The bar graphs on the Type A, Model 3 (Fig. 9) and the Type B, Model 2 (Fig. 10) lubricators show that a more consistent delivery rate was obtained through this type pump than through the pumps having sight feeds on the discharge sides of the pump. The drop of oil in the vacuum type pump is a free-falling drop within a vacuum and should be more consistent in size; hence, the delivery rate should be more uniform. Even though these two type pumps gave more consistent delivery with the drop method than the other types under test, several defects which were encountered question the advisability of converting to this pump. Loss of vacuum on the suction side of the pump caused complete stoppage in delivery from the pump. In a few instances during the tests, delivery was indicated through the vacuum sight feed, yet there was no delivery from the discharge side of the pump. The difficulties in the pumps were, in more cases, readily determined, but the tests were plagued with repeats on these difficulties.

OPERATIONAL DIFFICULTIES

The conscientious engine operator has for many years attempted to determine the true oil requirements necessary to insure proper cylinder lubrication. It is, therefore, readily understandable why he could not determine satisfactory quantities with delivery rates as inconsistent from the various pumps as these tests indicate.

Under apparent identical operations and under apparent identical rates of feed from the lubricators, it is readily understandable why spot checks of the cylinders of the engine would show overlubrication at one point, while lubrication starvation existed at an adjacent point. An operator would be extremely lucky if a low delivery rate pump was delivering into one cylinder along with a higher rate delivery pump, giving him a good overall average; but he would be just as unlucky and it would be just as highly possible to have two low delivery rate pumps delivering to the cylinder, creating the lubrication starvation condition.

The authors are of the opinion that continuously changing conditions as a result of these variable delivery rates, demonstrated by the bar graphs on the various pumps, have certainly been instrumental in influencing the engine operator to change his rates of

feed, and in causing the engine manufacturer to vary the number and position of the lubricator points within the cylinder. The fallacy in all of this is that when the operator or the engine manufacturer made a change in the lubricator adjustment, they did not get a consistent adjustment in the delivery; consequently, lubrication conditions were constantly changing, thereby giving variable conditions within the cylinders. Hence, they still did not know how much oil to use per engine, how many points of lubrication were required, and at what position to place the points of lubrication.

INITIAL CONCLUSIONS

It was concluded from these tests that a drop of oil is always a drop however its size may vary; that the drop method of adjusting the delivery rate with the sight feed on the discharge of the lubricator pump has value only as an indication of flow and not as a control of quantity; and that the plastic sight feed on the vacuum pump is too fragile and will leak when not properly seated. It was further concluded that extreme care must be taken to keep the lubricator reservoir clean and the lubricator pumps in top operating condition. It must not be assumed that adding clean oil to a lubricator reservoir insures cleanliness in the system. Lubrication of an engine cylinder is an important item, and consistent delivery of the oil to the cylinder must be insured for proper lubrication. Blame for poor lubrication should not be laid to the operator but instead to the various gadgets or sight feeds on top of the lubricator pumps that have not lent themselves to precise measurements of the delivery whereby each point shares in its proportionate part of the overall daily delivery of oil from the lubricator reservoir.

Two consistencies were noted with the "turns" method of adjustment. If a lubricator's output was below average at a high rate, it would also be below average when the rate was low. It was further noted that for a given change in flats, all pumps of the same type increased or decreased their output in almost like amounts. This was not true with the "drop-counting" method and indicated that if all pumps could be set for some initial output, the "flats method" could be used quite effectively.

Numerous efforts were then made to find some basic setting which would give the same delivery for each pump. Failure to find a basic setting may be attributed to manufacturing variations in rocker arms, lifter cams, reservoir mounting, etc.; so other methods of delivery rate adjustments were investigated.

After the "drop-counting" and the "turns or flats" method of delivery control proved so inconsistent, the authors turned to the stroke of the lubricator pump plunger as a means of control.

STROKE METHOD

The lubricator pump is essentially a positive displacement pump. Its delivery is a function of the plunger cross-sectional area, the number and length of plunger strokes, and the efficiency of the pump. Noting this fact, it became necessary only to devise a means of measuring the stroke length and of determining the rpm of the lubricator cam shaft.

The stroke measuring method was accomplished by attaching a small stainless steel rod to the spring retainer plate (Fig. 11) in such a way that this rod could extend through a small hole in the body of the pump. The movement of the pump plunger could then be measured with a dial test indicator. Results, using this method, are shown in Fig. 12.

Additional laboratory tests resulted in a delivery chart which closely approximated the theoretical calculated delivery (Fig. 13). The variation from theoretical delivery may be attributed to check valve operation and slippage around the plunger.

All tests on the lubricator pumps to this point were made with the delivery at atmospheric pressure. The additional variation due to the effect of pressure on pump delivery was then investigated.

PRESSURE EFFECT

The pressures against which a number of pumps were operating in actual service were determined by pressure gauges inserted in the delivery lines to the various points of service. Power and scavenger cylinder pumps were delivering against pressures approximately 100 psi. Gas compressor cylinders and compressor rod packing lubricators were delivering against pressures equal to the discharge gas pressure of the cylinders.

A compression chamber (Fig. 15) was constructed which permitted testing of the pump outputs against pressures up to 1,000 lbs. During these tests the chamber was pressurized with nitrogen prior to the start of oil delivery. Fig. 16 represents the results of tests on eight pumps operating against different pressure conditions.

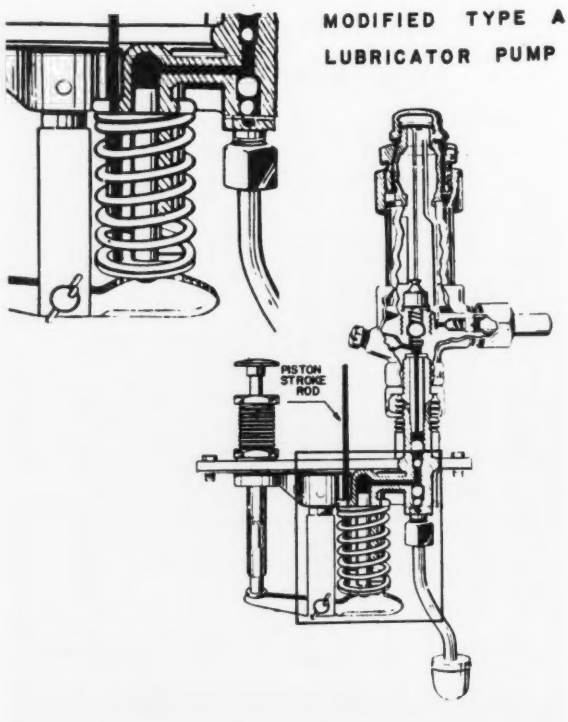


Fig. 11. Schematic of Modified Type A, Model 2 Pump.

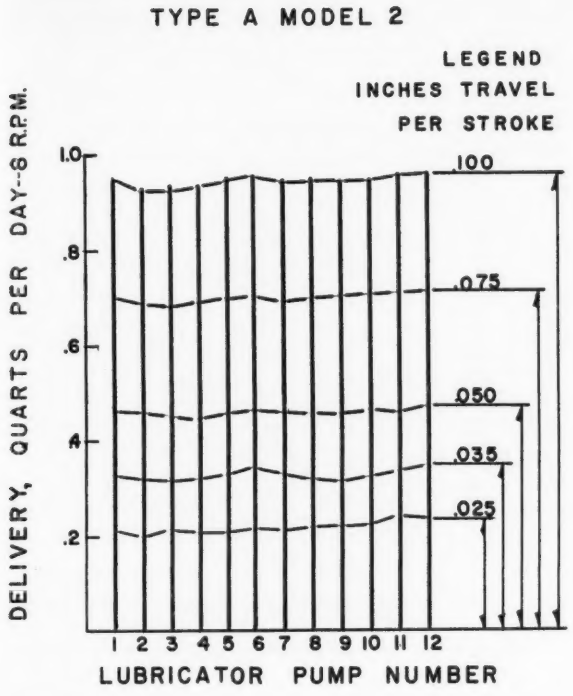


Fig. 12. Type A, Model 2 Deliveries—Stroke Method.

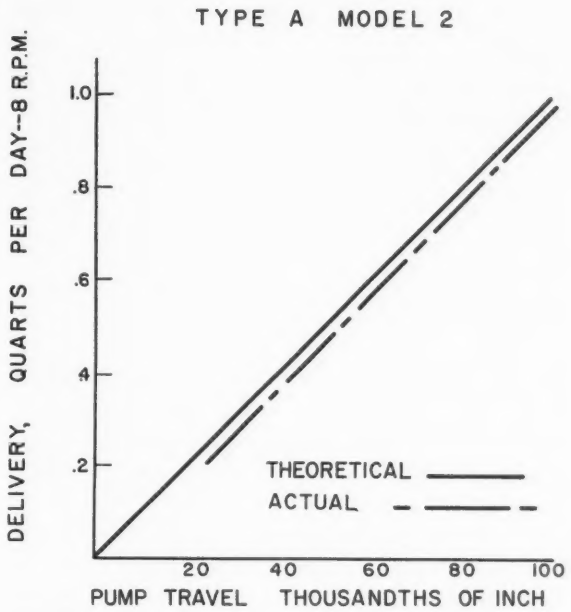


Fig. 13. Type A, Model 2 Deliveries—Actual and Theoretical.

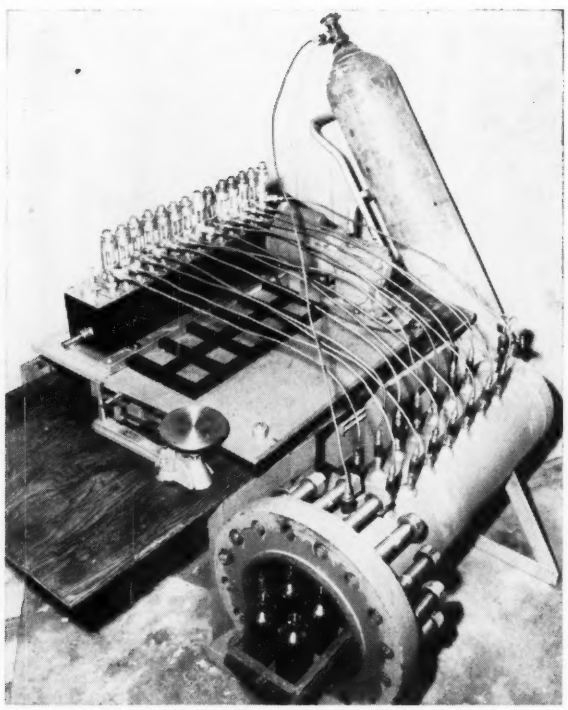


Fig. 15. High Pressure Test Chamber.

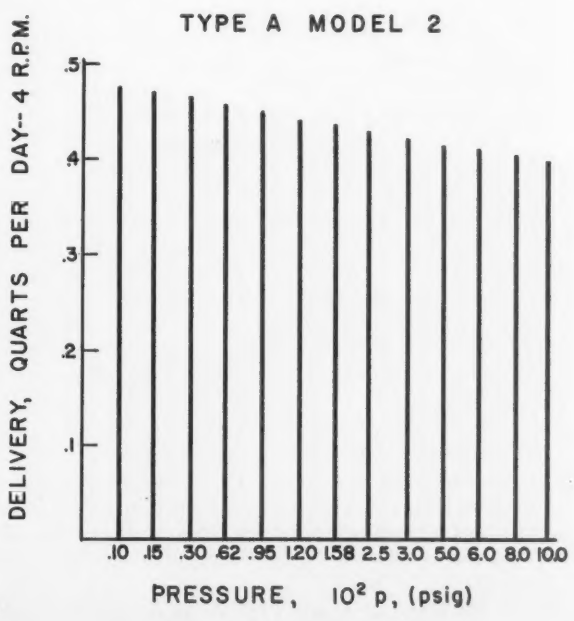


Fig. 16. Type A, Model 2 Pressure Deliveries.

HIGH TEMPERATURE EFFECT

The effect of high oil temperature on pump output was also checked with the apparatus shown in Fig. 14. The lubricators were run at 80 F. one day, and at 140 F. the next day at the same stroke setting. A maximum variation of 3% was noted. Thus, it would appear that high engine room temperatures have little effect on pump output for this variation is in line with temperature cubical coefficient of expansion. Low temperature effect is yet to be tested.

FIELD MODIFICATION

With the completion of satisfactory delivery charts, the decision was made to carry the modification of the Type A pumps to the field personnel. A template (Fig. 20) which would permit the drilling of the pump body for the stainless steel rod, a jig (Fig. 21) for drilling the spring retainer plate, and an adapter for conveniently mounting the dial test indicator were designed and manufactured. These were included along with drills, stroking rod, a dial test indicator, and an instruction booklet in a modification kit which was shipped to each field location. These kits cost in the neighborhood of $75.00 each, and contained sufficient equipment to modify approximately 2,000 pumps at the largest locations. Modification has been in progress for eight months and approximately 10,000 pumps have been modified up to this time.

As each unit was modified, the required stroke length for a given rpm was determined from Fig. 18, corrected for pressure with values taken from Fig. 17, and the stroke adjusted as shown in Fig. 19. During the first few days' operation, the actual reservoir consumption was balanced against the stroke calculated delivery and the stroke length adjusted accordingly to calibrate the lubricators. During the modification program, pumps were found lacking parts, some would not deliver oil, and many were extremely dirty. A general overhaul and clean-up went hand in hand.

Lubricators were found whose rpm varied from day to day. Overhaul of the drive mechanisms was also required. Some locations report that a fast rpm in excess of 8 permitted better seating of check valves. Other locations reported that a slower rpm of 2 to 3 with its longer stroke permitted a more accurate setting of stroke length and prevented the delivery failures due to prime loss, which is obtained with very short strokes. At one location flow of all three feeds to a cylinder has been taken through one pump to permit long stroke operation.

Field acceptance of the program has been most encouraging. The operators have known for a long time that their control of lubrication was inadequate, as were their previous tools for controlling it. It is now the general feeling that they have an accurate quick means of controlling the delivery from each lubricator pump.

Modification of the Type A, Model 3 lubricator to the stroke method has been accomplished for laboratory tests only. Modification of the Type B, Model 1 lubricator has been accomplished for laboratory tests

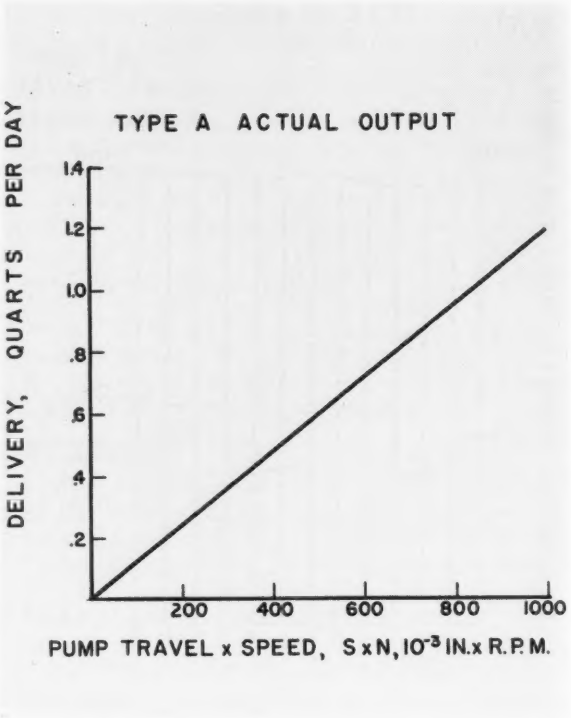


Fig. 18. Type A, Model 2 Atmospheric Deliveries.

through the addition of a check valve on the submerged end of the suction line of the pump to give check valve to check valve operation. Additional work will be required on the modification of the Type B, Model 2 lubricator.

"O" RINGS

The Type A, Model 4 pump was tested against pressure. Leakage around the upper end of the plunger amounted to an average of 80% of the total output of the pump. The installation of "O" rings on the plunger offered a possibility of overcoming this slippage. A number of pumps were fitted with "O" rings and tested in the laboratory to obtain a delivery chart. An adapter was then designed which would permit the measurement of the stroke length and the pumps were sent to the field in order to test the life of the "O" ring.

Success in overcoming the leakage in the differential pump led to a decision to attempt to recover discarded Type A, Models 1 and 2 pumps. According to field personnel, these pumps were so badly worn within the cylinder bore that they would not deliver sufficient pressure to overcome the compressor pressure. They were fitted with "O" rings and returned to the field for testing to determine the optimum combination of groove dimensions and "O" ring material to give maximum life. It it hoped that this procedure will permit the reclaiming at a minimum expense of a large percentage of the pumps which would otherwise have gone into the scrap heap.

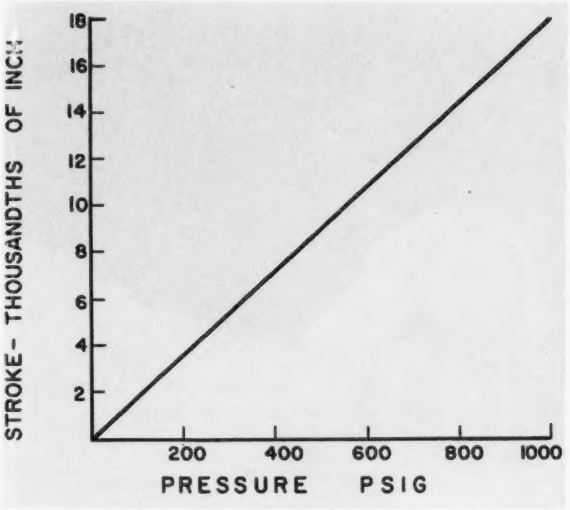


Fig. 17. Additional Stroke Requirements.

Numerous tests resulted in a correction chart (Fig. 17) which gives the amount of additional stroke length required for a given pressure to compensate for the reduction in efficiency. This type of chart was considered to be the most convenient for field application.

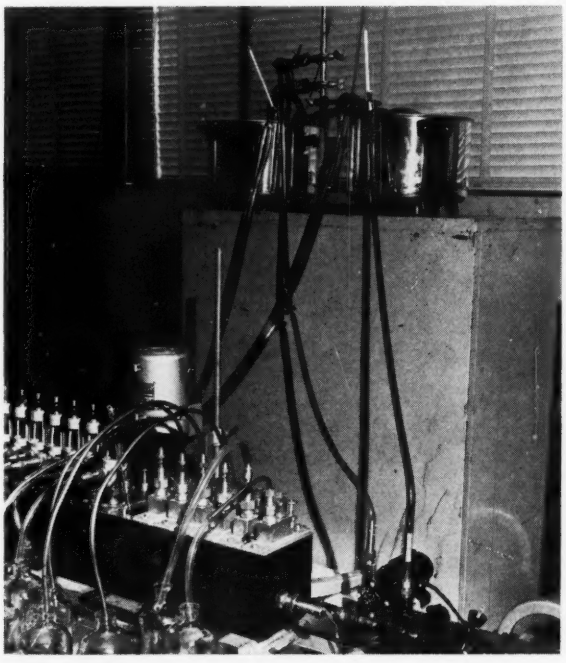


Fig. 14. Type A, Model 2 Deliveries—High Temperature Test.

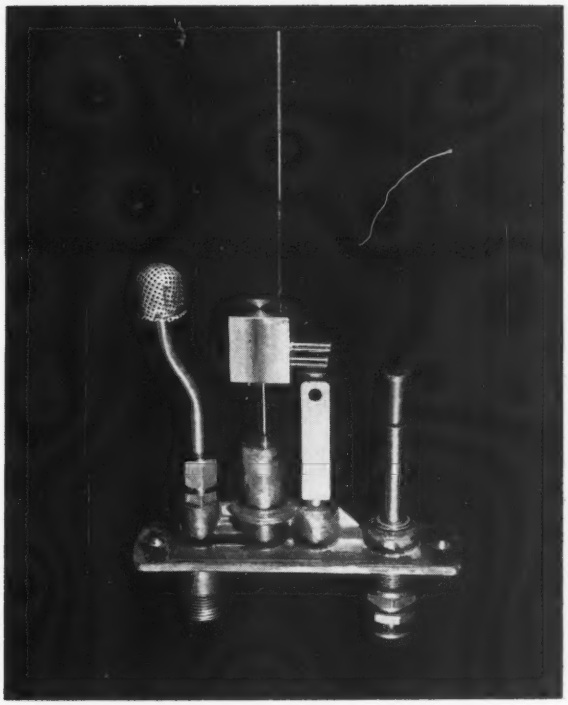


Fig. 20. Drill Template for Type A, Models 1 & 2—For Body.

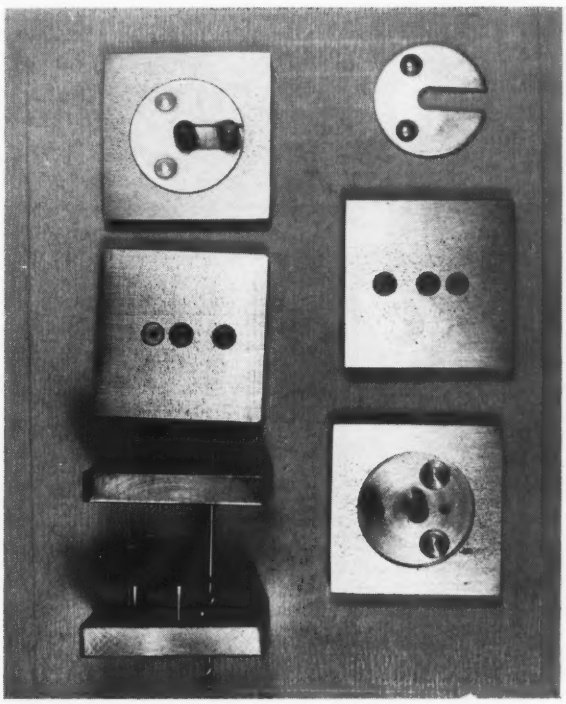


Fig. 21. Drill Template for Type A, All Models—Retainer Plate.

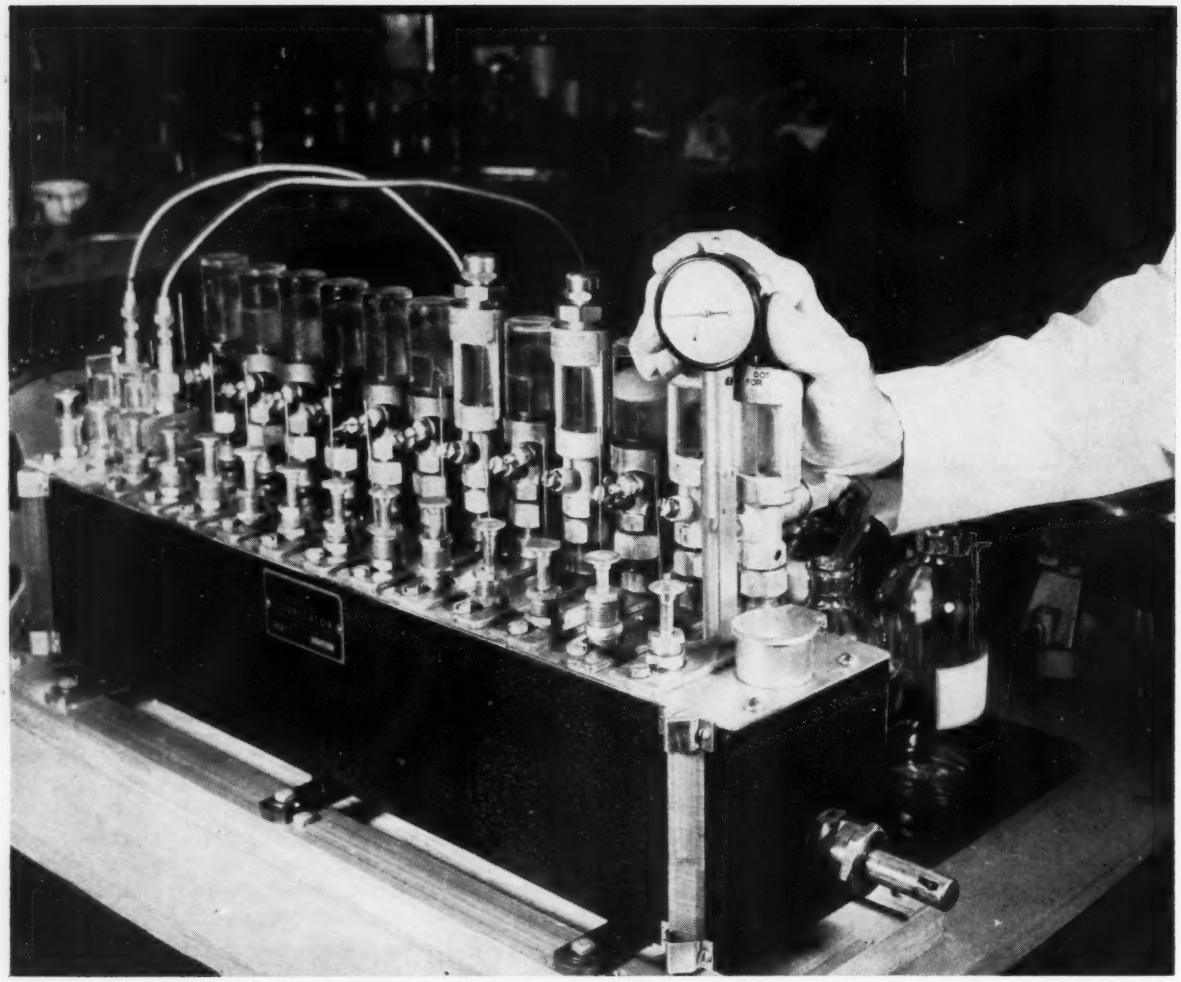


Fig. 19. Adapter and Indicator in Use.

CONCLUSIONS

The modification program has been more than justified by a number of reasons which extend beyond the actual control of lubrication. Field experience has shown that one can not go by the fact that one thinks he is using clean oil. The lubricator reservoir and pump system must be cleaned frequently. In most companies the least experienced and poorest trained man is given the title of oiler and, in many instances, is given the responsibility of the lubrication of the operating equipment. Furthermore he is the first man to be promoted when a new job opens up and as a result, you have a constant changing personnel. All this oiler knows to do is fill up the reservoir and maintain delivery from the lubricator pumps. In fact, in many cases he has no idea as to which pump serves what lubrication point. The lubrication of the equipment is looked upon as a menial task, but it is far from such.

Under this modification program each pump takes on individual characteristics in that its delivery must be adjusted in accordance with the point which it serves. This new awareness of the importance and complexity of lubrication has lifted the duty from a menial chore to one of prideful importance. The quantity control, as in the past, will be at the reservoir in accordance with the total daily consumption, but more accurate control at each particular point has been added.

There is the possibility that the future may yet hold much more in store for the modification. The engine manufacturer may have his questions answered as to 2, 3, or 4 points of lubrication, and as to position up and down the cylinder wall with reference to ring travel. Spot control can be visualized, for it is reasonable to assume that more oil should be used on the thrust or hot side of the piston. These types of investigations may then be followed by quality tests of lubricating oils, bearing materials, ring materials and configurations; and some day, a reasonable value may be determined for the consumption per brake-horsepower hour.

Lubrication should be placed under the supervision of the most qualified man who is most apt to see what is going on in the engine and knows whether or not each particular point is getting proper lubrication. No claims are made for the modification program as a panacea, but much value can be realized in the form of lubrication consciousness and desire to obtain optimum economical operation.

DISCUSSIONS

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Gulf Research and Development Company
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We wish to take this opportunity to congratulate the authors for pioneering a method to allow better control of cylinder lubrication through a simple and economical modification of presently installed force feed lubricators. We are interested in this method as a part of our engineering service to our customers and for use in more accurately controlling a lubrication rate during experimental oil development service tests.

We recognize that the rate of lubrication can have a greater influence on engine and compressor cylinder deposits than differences between lubricating oils. Therefore, during a lubricating oil service test, it is important to have both oils compared at the same rate of application. Through the courtesy of Mr. Hiram Moore, we were made acquainted with the calibration project described by the authors, and built similar adapters for the dial indicators.

We were interested in doing cylinder lubricating oil development work in diesel and gas-fueled engines which use a different make of lubricator. A study of this lubricator indicated that the same method of modification as used by the authors could be used, but an even simpler method requiring no pump modification might also be used. This simpler method requires only the removal of the priming plunger from the pump assembly box and the insertion of a feeler gauge stem to ride on the cam follower foot. This system worked satisfactorily when the pump stroke was measured by turning the cam shaft very slowly, but required further improvement when applied to operating engines.

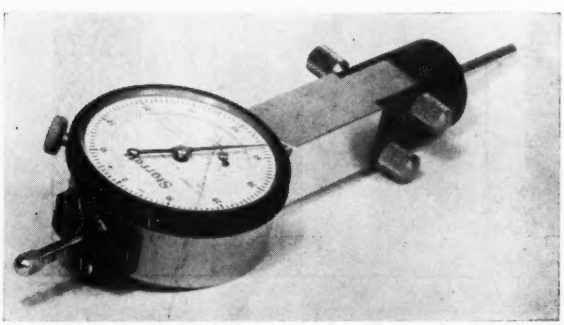

Figure A1-Calibration Gauge for Force Feed Lubrication Pumps Head View Showing Friction Hold Device

Figure A2

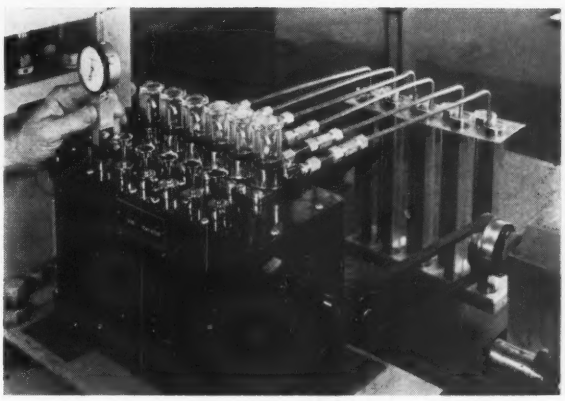

Figure A3

The lubricators on our engines turned at 1/6th engine speed. The engines of immediate interest operate at 225 and 257 rpm with one cam lobe per pump. The calibrations were then attempted with the pumps turning the normal speed (37.5 rpm, corresponding to 225 engine rpm), but the rapid cam rise rate made it impossible to read the feeler gauge. A simple friction stop was devised which allowed the feeler gauge rod to rise to maximum and then stay there to be read even after removal from the lubricator box.

Fig. A1 illustrates our lubricator calibration gauge equipped for use on this lubricator. By removing the four knurled screws, the adapter described by the authors may be fitted to this same unit.

Fig. A2 and A3 illustrate the method of calibration used for the liquid sight feed type and vacuum type sight feed pumps. The discharge from each pump passes through an engine check valve into the 100-cc graduate. Fig. A4 and A5 are plots of the results of these calibrations. Our results confirm those reported by the authors and indicate that the volume of oil discharge by different pumps varies widely at the beginning of the pump stroke, apparently due to differences in location of the pump intake ports. Therefore, under these conditions, the drop counting system, around which the lubricators were designed and have been used for many years, is the most accurate.

Fig. A4 and A5 illustrate the individual pump flows at four different pump plunger travels and at three different lubricator shaft speeds. It can be seen in Fig. A4 that our vacuum type pump operating at 0.25 inch plunger travel delivered 100% more oil through pump No. 3 as compared to pump No. 2. However, at 0.40-inch plunger travel this variation had been reduced to a ratio of 6:5. It is our belief that a modified foot valve on the pump suction could reduce this variation still further.

Results of similar calibrations on the liquid sight feed type lubricators is shown in Fig. A5. These standard production pumps had larger diameter plungers and, therefore, gave higher delivery rates for the same plunger travel. Calibration runs were made at very short plunger travels in an effort to find a calibration to allow delivery at the rate of two-third quart/day per cylinder injection point (6 per cylinder). The average pump plunger travel at this rate is only 0.15 inch. However, the variation between these six pumps was again 100% at this low rate, leading us to the conclusion that on engines with this pump installed, it is more accurate to count the drops rising through the liquid than to depend on the simpler, faster method we were trying to develop. We also concluded that a pump with smaller diameter plunger was required to assure more uniform delivery rate at the low flow rates required by the 225-rpm engine in which we were interested.

At the higher discharge rates the variation from pump to pump is much smaller. The normal rate of feed desired from these pumps is at the lower, less accurate rates. Therefore, it has been suggested that one method of using this information is to use only every other pump and a flow divider with this pump. The pump being used would operate at double normal capacity and, therefore, be in a more reproducible flow range. We have not yet found suitable flow dividers for this purpose, but our program is continuing.

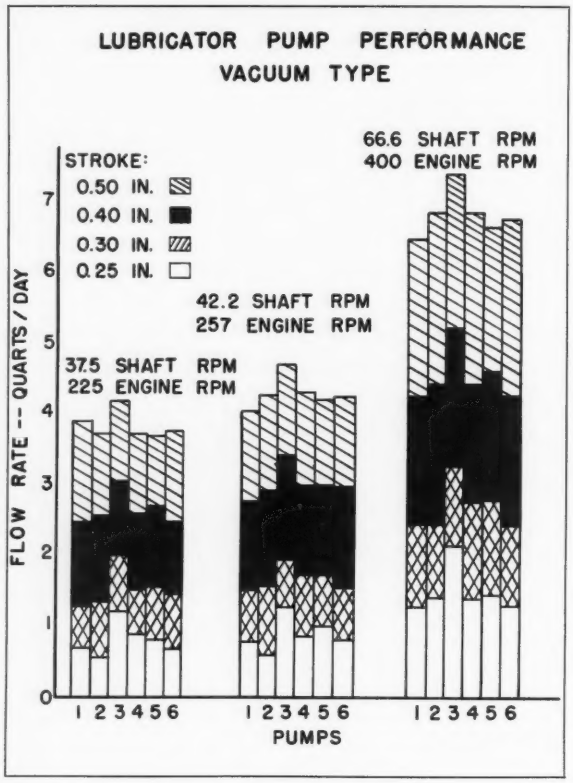

Figure A4

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The authors of this paper are to be commended for an interesting scientific approach to a problem that I think most of us who call ourselves "Lubrication Engineers" have recognized for a long time but have done little to correct. They have recognized a problem, investigated the reason for it, and now have set out upon a course to correct the difficulty. I am glad to be near Messrs. Churchwell and Kokas to follow the success of this program.

Their paper affords an excellent explanation for the paradox that may be found when inspecting an engine that is "down" for periodic inspection or even because of failure. It was difficult at times to attempt to explain to an operator why rings were stuck and excessive deposits found in one or several cylinders, whereas another may have failed because of a scored piston and piston rings. In a case of this type, the operators naturally are on the defensive because the finger usually pointed at them for not paying close attention to oil feeds. Excessive oil fed to an engine cylinder will promote ring sticking, combustion chamber deposits, and valve difficulties; whereas, insufficient oil can cause an almost immediate failure through piston and ring scoring or even acute piston seizure. In air compressors, the situation may be even worse. Excessive oil feeds cause deposits on the pistons and in compression chamber, and dangerous oil accumulations in the discharge lines, and receivers, which in many cases, have added up to an explosion. The authors have set up an excellent procedure to correct this situation throughout their operations. They, fortunately, operate enough engines and compressors so that the number of lubricators justify such an extensive program. Their work, however, should be carried also to the smaller operator,

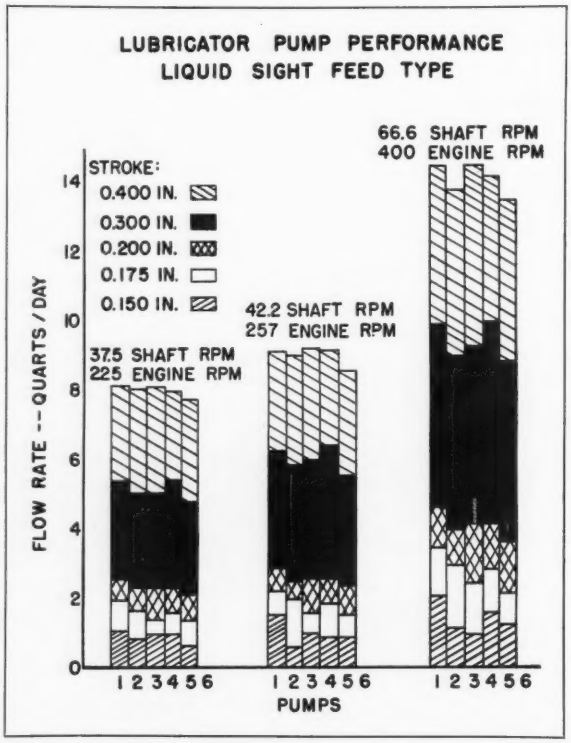

Figure A5

who has only a few lubricators to service, to help him set up a plan whereby he can make a periodic check on his lubricators to maintain a high standard of lubrication.

The success of any automatic lubrication device depends upon very close co-operation between the operators, the oil suppliers, and the lubricator manufacturers.

The oil supplier is held responsible to furnish a suitable lubricant for the equipment involved. The selection of such a lubricant and/or lubricants should be arrived at through a clear-cut decision by the man in charge of lubrication for the operator and the lubrication engineer of the supplying company. Their decision must be based on the requirements of the equipment and cannot be circumscribed by the ability of the lubricator to handle it.

The operators are charged with the responsibility for having the lubricant applied in the correct amount to the right place at the right time to secure utmost efficiency from their equipment. Whereas, emphasis in this paper is placed upon the lubrication of gas engines and compressors, these statements can be extended into the realm of other types of engines, air compressors, and other industrial machinery. The operator must maintain clean practices in handling of lubricants and establish a rigorous maintenance program on his lubrication equipment. In the case of mechanical force-feed lubricators, experience will dictate the interval, but he definitely should have a program whereby the feed rate is periodically checked, the pumps are checked for "leak-back," and the reservoirs cleaned.

The operator should have a definite, concise, and simple method to check the rate of feed of all lubricators periodically. The authors have pointed up several methods that can be adopted economically also by the smaller operators. Certainly the few dollars spent for lubricator maintenance and adjustment is cheap protection against costly equipment failures and even more costly "down time."

Lubricator manufacturers have advanced a long way and are doing a fine job in providing automatic lubricators. Higher output machinery is ever more demanding on automatic lubricators. Reference will be made to this later.

The authors have shown the lack of relationship or correlation between the number of drops and the volume of oil delivered, both when counted on the delivery side and on the intake or vacuum side of the pumps. They pointed out further that the greatest deviations exist when the drops were counted in the sight glass on the delivery side of the pump. In other words, their findings might be restated as "when is a drop a drop, a drip, or a glob?" From both laboratory work and field observations we can substantiate these inconsistencies. I believe, however, the drop may be studied further where it still can be used as a unit of measure by the smaller operator. Some other method, of course, must be used on lubricators with "blinker" and "bobber" indicators.

The size of drops in the sight glass of a lubricator is controlled by three very distinct factors: oil characteristics, including viscosity and additives; density and nature of fluid in the sight glass; and shape and condition of the feed orifice. Oils of higher viscosities naturally form larger drops than those of lower viscosities; whereas, additive materials, depending on their nature, reduce or increase the size of the drops.

Density of the sight glass fluid also is a big factor. I think we all realize that glycerine will form a smaller drop than will water; however, if a small amount of soap is added to the water, the size of the drop can be reduced to such an extent that it actually ceases to exist but becomes a fine stream flowing through the liquid medium.

A feed orifice with a thin lip that is well polished will form a much smaller drop than will one with a heavy rough lip. Furthermore, the drop will break more readily from a highly polished metal surface than it will from one that is corroded or dirty. All three of these factors separately will affect the size of the drop.

It is believed that some of these factors may account for some of the irregularities and inconsistencies reported when using the drop count method. The condition of the orifice alone could account for some of these discrepancies. In small plants, where this method is used, it is recommended that the feed pipes either on a vacuum-type feed or in the usual liquid-filled sight glass be thoroughly polished on the end and kept free from any deposits. With these precautions, it is believed that a lubricator can be calibrated by the small operator to give a reasonable degree of accuracy by using the drop count to regulate the rate of feed.

The authors state "Who's to say if a gas engine is receiving the correct force-feed lubrication?" To this, we might add "in the correct place at the right time." This, together with the authors' Fig. 16 showing the effect that pressure within the cylinder has on the delivery rate of a pump, points up two areas that warrant exploration.

The first is the development of a pump having a long life that can deliver accurately metered amounts against high pressures, such as those encountered primarily in air and gas compressors but exist also to a certain extent in the cylinders of diesel and gas engines. In this day of high pressures, a mechanical force-feed lubricator is called upon to perform much the same function as a diesel engine fuel injector. I wonder why the same principles cannot be employed. The authors have shown that a longer stroke of the pump will deliver more accurate amounts of oil. This is, undoubtedly, due to lower leakage losses around the plunger which might indicate further that a page be taken from a diesel injector design book, using a plunger with a helical metering slot cut in its side similar to that used by several of the leading diesel injector and pump manufacturers. This pump could be operated at a constant stroke and the amount of oil metered by rotating the plunger. This type of design, together with the same degree of precision of a diesel injector, would permit accurate deliveries at high pressures.

This leads to the second phase—that of putting the oil into the cylinder at the right place at the right time. The ideal condition for the lubrication of an engine power cylinder is to apply all of the oil directly to the ring band or between the two ring bands on the piston so that it can be wiped over the cylinder and piston walls before it is exposed to the flame of combustion. This, of course, brings about "timed" lubrication. This has been used for many years on large slow-speed gas engines and is worthy of consideration for large high-speed gas or diesel engines as well as for compressor cylinders and pistons. Timed lubrication requires delivery of the oil during the very short time interval that the desired part of the piston is exposed to the oil holes. In the case of a four-cycle engine, the oil can be applied to the piston toward the end of the combustion stroke, thus giving three strokes of the piston to distribute it over the cylinder walls before it is exposed to the hot combustion gases. On a two-cycle engine, the ideal probably would be to apply the oil to the piston on the compression stroke just above the exhaust ports. This method requires accurate metering and high speed delivery with precise timing. This method has the possibility of giving superior lubrication with reduced oil consumption.

Mr. Churchwell and Mr. Kokas have done a fine piece of work which can be used as a guide for studying difficulties encountered in automatic lubrication of modern high-speed equipment as well as pointing to several areas that require further research and development.

Editor's Note: Authors are furnished a copy of each discussion and invited to submit a closure. Since no closure was submitted for the above article, it may be assumed that the author(s) either concurred with the discussor(s) or did not feel that a reply was necessary.

A Service Evaluation of Detergent Lubricating Oils Utilizing Electron Microscopy

by S. R. Rouze and F. A. Forster
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Previous work (1) has shown that the effective detergency level in used lubricating oils can be determined by electron microscopic examination of the dispersed solids. Based upon these results, it was the objective of the work to be described to follow the detergency level remaining in used lubricating oils by electron microscopy rather than by periodic inspection of engine parts during the test. This was done, and when detergency was lost (based upon electron microscopic examination) the oils were changed. Upon completion of the test, it was found that the sludge and varnish ratings of engines operated with oil changes based upon electron microscopy were at a satisfactory level. Test conditions, sampling procedure, and specimen preparation method will be described, and the results obtained will be discussed.

INTRODUCTION

The formation of harmful engine sludge has been, for many years, one of the problems facing the automotive and petroleum industries. Sludge forms upon the internal parts of an engine as it is run, and is particularly troublesome in low-duty service: that is, on short trips, and the stop-and-go type of driving encountered in modern urban areas.

One method of controlling the amount of sludge formed in an engine is through the use of detergent oils. Previous work (1) has shown that the performance of a detergent oil, from the standpoint of its ability to prevent sludge, can be predicted by electron microscopic examination of the solids dispersed in the oil. However, this investigation was performed on oils used for long periods in severe low-duty service (taxicab operation), and it remained to be shown whether or not the same conclusions could be reached with fewer miles of operation, and under less severe conditions of operation more nearly like those encountered by the average motorist. To accomplish this, a road test program was designed to study the performance of detergent motor oils in engineering test cars. These cars were not experimental in the sense that they were run on a test track, but were cars used for general transportation. They were ideal for the purpose because they represented all types of driving: i.e., from occasional long trips, to general city and suburban driving.

TEST PROGRAM

The road test program was divided into two parts: in Part I, the purpose was to study engine cleanliness (sludge, varnish, rust) as a function of the detergency level in the lubricating oil for average driving conditions. Three cars of the same make and model were run on each of four oils having additive treatment levels as listed in Table 1. MIL level refers to the oil having passed the designated military test, particularly for oxidation and detergency level; Supplement 2 is similar, except that the detergency level is higher—approximately twice as great. These four oils were experimental oils, and were designed to vary only, insofar as possible, in their detergency level. Oil drain periods were normal (2000 miles) and oil filters were changed at 6000 miles.

TABLE 1. Detergency Level of Oil Used in Test

LUBRICANT	ADDITIVE TREATMENT LEVEL	DETERGENT
A	Premium	None
B	MIL-L-2104A	Conventional
C	Supplement 2	Conventional
D	MIL-L-2104A	Polymeric

In Part II, the purpose was to determine whether or not satisfactory engine operation and engine cleanliness could be achieved with oil change intervals based upon periodic electron microscopic examination of the used oil. Lubricant C was used for this part of the program in six cars. In one set of three cars, the oil was changed at intervals at 2000 miles. In the second set of three, drain periods were based upon the examination of the suspended solids in the oils by electron microscopy. Oil filters were changed at 6000 miles.

EXPERIMENTAL PROCEDURE

Before the test program began, the cars were run in on factory-fill lubricants for 1000 to 2000 miles. The engines were then drained, and new measured camshafts and lifters installed. After filling with the test oils, the cars were driven for approximately one year, with small samples of oil being removed at 1000-

mile intervals for inspection in the electron microscope. At the completion of the test, the engines were disassembled and inspected for cleanliness (sludge, varnish and rust) and for wear.

Specimens of the oils were prepared for examination in the electron microscope using a modification of the printing technique (2) Briefly the method is as follows: A parlodion film (or substrate) is first cast on the surface of distilled water from one percent solution of parlodion in amylacetate. A drop of oil is placed on a clean glass microscope slide and spread to make a thin film. The slide with the oil film is placed gently on the parlodion film and then carefully removed. This procedure allows the first few layers of the oil film to transfer, or print, on to the floating parlodion film. Using a small annualar wire loop, a section of the printed substrate is then transferred to a conventional electron microscope specimen screen and allowed to dry. After drying, the specimen is ready for examination in the electron microscope. To guard against contamination and to insure high standards of cleanliness, periodic checks were made of the substrates in the electron microscope.

Two types of specimens were examined: one specimen was drawn from the whole, used oil after thorough mixing and represented the condition of the oil as it was drained from the crankcase. An examination of this sample permitted an evaluation of the dispersion and the relative amount of solid material in the oil. After the oil sample had been allowed to stand undisturbed for several days, another specimen was withdrawn from the supernatant liquid which formed at the top of the sample when the heavier particles settled out. This supernatant liquid contained either no particles or only the very fine ones, and when compared with the whole, mixed oil, an estimate could be made of the oil's effectiveness in keeping solids suspended upon standing. While it is true that the dispersing quality of an oil and its ability to keep solids suspended are closely related, we believe, nevertheless, that both types of specimens must be examined in order to evaluate the effective detergency of a used oil. For each sample, at least four specimens of whole oil and four specimens of supernatant liquid were examined. A representative specimen of each type was then selected, and a series of five electron micrographs recorded. For the entire program more than 1400 specimens were prepared and over 1750 electron micrographs recorded to evaluate the oils.

DISCUSSION OF RESULTS

Considering the results of Part I first where four oils having different levels of detergency were investigated, Fig. 1 shows electron micrographs of the four oils at a car mileage of 2000 to 4000 miles (the oil had been changed at approximately 2000 miles). In the non-detergent oil, Lubricant A, the suspended particles are beginning to agglomerate and there are comparatively few fine particles. In the detergent oils, on the other hand, the solids are well dispersed.

After a car mileage of 5000 to 7000 miles, samples of the four types of oil appear as shown in Fig. 2. The most significant change is in the engine using Lubricant B, the oil with a low level of detergency. The

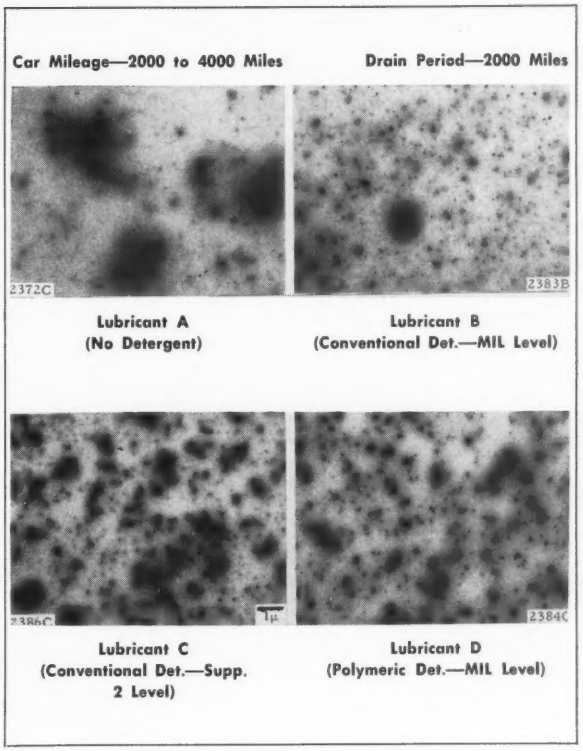

Fig. 1 ELECTRON MICROGRAPHS OF WHOLE OIL

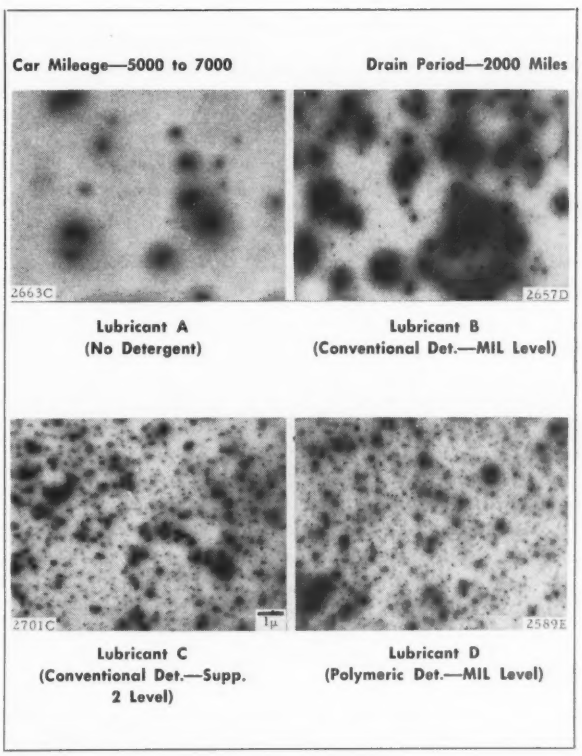

Fig. 2 ELECTRON MICROGRAPHS OF WHOLE OIL

tendency of the particles to clump together shows that the detergency level of this oil is too low to prevent agglomeration of solid material at this car mileage. The other detergent oils, however, still disperse the solid material well.

After 7000 to 9000 miles of car operation the oil samples appear as shown in Fig. 3. Here it is apparent that the detergency level of Lubricant B is no longer sufficient to keep the solids dispersed in engines operated for this distance. Lubricants C and H, however, still possess adequate detergency to provide adequate dispersion.

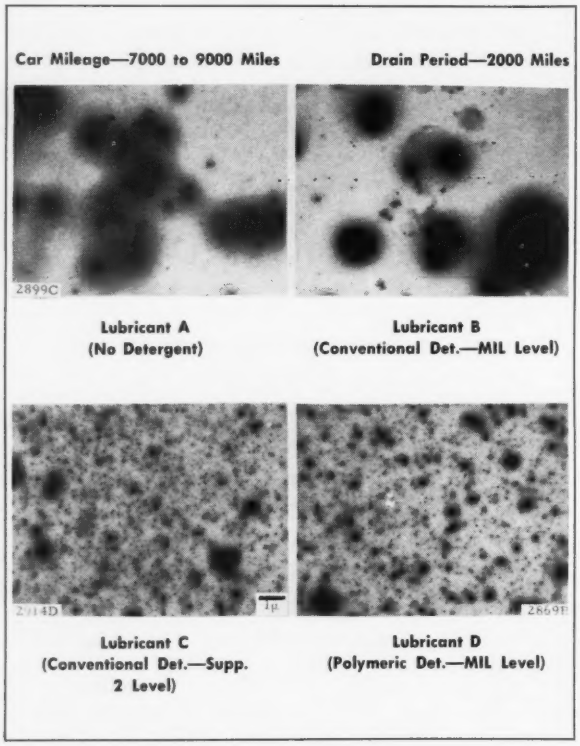

Fig. 3 ELECTRON MICROGRAPHS OF WHOLE OIL

After 10,000 miles of car operation (Fig. 4) only Lubricants C and D appear to have sufficient detergency to disperse the accumulated solids. Even in these oils a tendency of the particles to aggregate is noticeable.

As stated previously, specimens taken from the supernatant liquid at the top of the oil samples that had been standing undisturbed for several days were also examined to determine the ability of the oil to keep the solid material suspended. Considering the electron micrographs of the supernatant liquid and whole oil specimens of Lubricants A and B after a total car mileage of 5000 to 7000 miles (Fig. 5), it can been seen that the whole oil of Lubricant A contains a

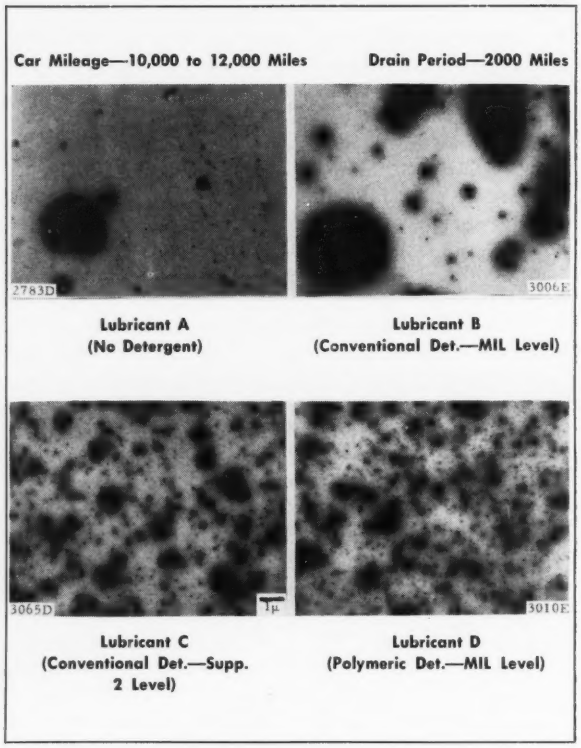

Fig. 4 ELECTRON MICROGRAPHS OF WHOLE OIL

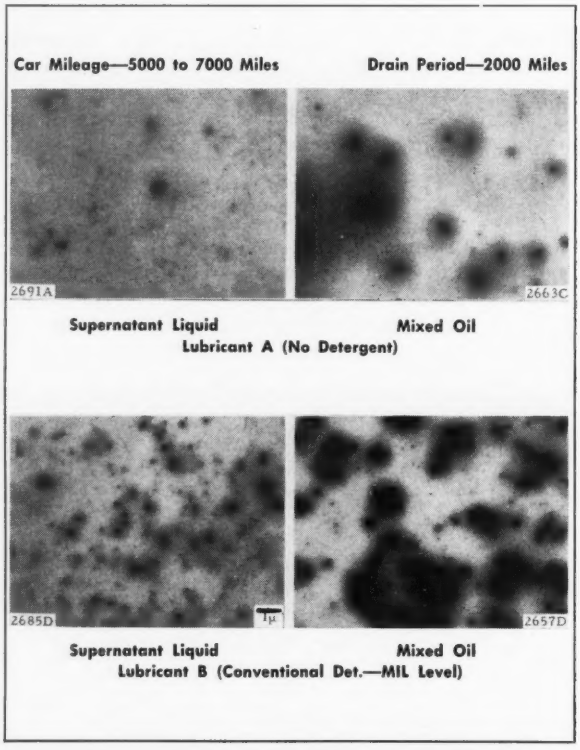

Fig. 5 ELECTRON MICROGRAPHS OF USED OIL

large amount of solid material while the supernatant liquid contains relatively little; i.e., Lubricant A has very little or no ability to hold the solid particles in suspension. Lubricant B, on the other hand, holds a great amount of material in suspension in the supernatant liquid. At a car mileage of 10,000 miles, however, (Fig. 6), Lubricant B appears no more effective than Lubricant A. Micrographs of Lubricants C and D at a comparable mileage (Fig. 7) indicate that the detergency level of these oils is sufficient to disperse the solid materials and keep them suspended.

For the series of micrographs just discussed, the oil was changed every 2000 miles, and the micrographs were taken just prior to the oil changes with approximately 2000 miles on the oil. It is concluded from these micrographs that for the first 6000 miles of engine operation, an oil of MIL level detergency retains an adequate detergency level throughout the oil drain interval of 2000 miles. After a total mileage of 6000, however, a MIL level oil is no longer adequate for the entire drain interval, and an oil of higher detergency must be used if effective detergent action, and thereby a clean engine, is to be maintained.

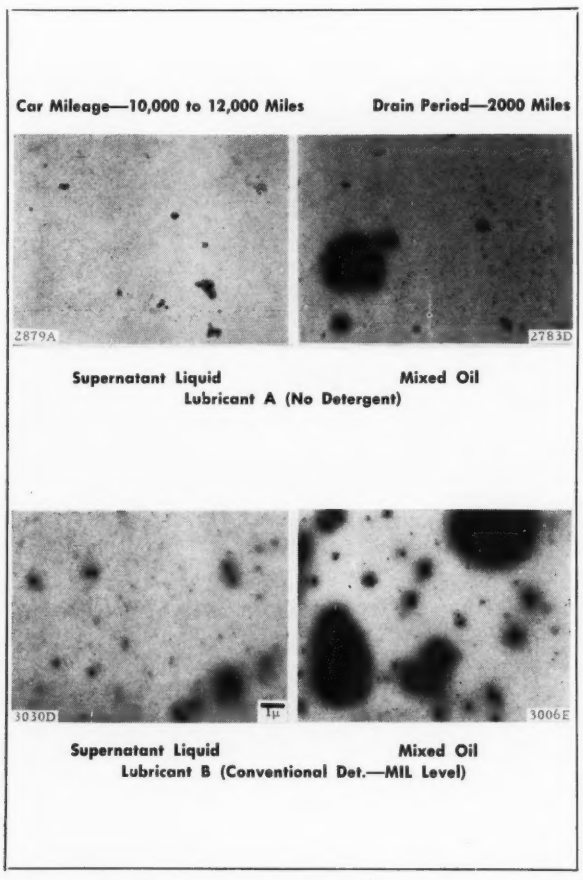

Fig. 6 ELECTRON MICROGRAPHS OF USED OIL

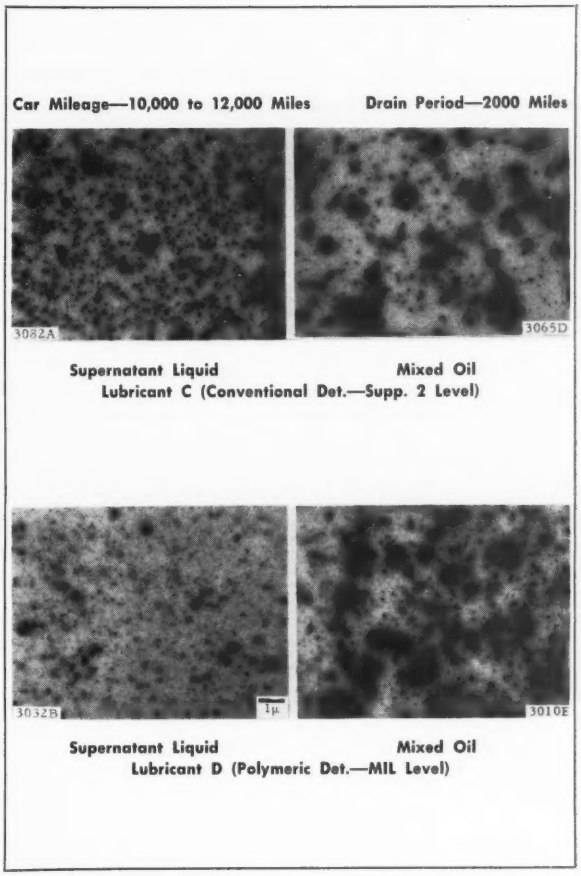

Fig. 7 ELECTRON MICROGRAPHS OF USED OIL

A detergency requirement of an engine may therefore be described where detergency requirement is defined as that detergency level necessary, at a particular engine mileage, to give a reasonable complete dispersion of the accumulated solids. In view of the results obtained in Part I, it may be concluded that the detergency requirement of the engine *increases* as the total car mileage increases, even though the oil is replaced with fresh oil at 2000 mile intervals. While a MIL level oil was adequate when the engine was new, a Supplement 2 oil was needed to maintain a satisfactory level of detergency after 6000 miles of car operation. This increased detergency requirement of an engine may arise for a variety of reasons. For example, not all of the oil (and therefore not all of the suspended solids) is drained when the oil is changed. This is particularly true when oil filters are used. Particles which deposit on interior engine surfaces near the end of a drain interval may be re-suspended when new oil is added, thereby decreasing the effective detergency level of the fresh oil. Also, the tendency of an engine to form sludge may increase with mileage due to increased blow-by or other factors.

An evaluation of the condition of engine parts after tear-down at the completion of the program is shown in Table 2. In this rating system a score of 100 indicates a clean engine. Considering for the moment only those cars with an oil drain period of 2000 miles, Lubricant A (no detergent) showed the poorest sludge rating. This was expected. This lubricant also showed the poorest varnish and rust rating. The best oil from the standpoint of cleanliness is Lubricant C. Lubricant B fell intermediate with respect to A and C.

TABLE 2. CLEANLINESS OF ENGINES

TEST OIL	ADDITIVE TREATMENT LEVER	CAR NO.	TEST MILES	OIL DRAIN PERIOD	SLUDGE RATING	VARNISH RATING	RUST RATING
A	Premium	653	10224	2000	66	68	96
		663	13843	2000	71	69	88
		650	6936	2000	73	66	89
				AVERAGE	*70*	*68*	*91*
B	MIL-L-2104A	664	7100	2000	82	71	98
		656	10837	2000	79	91	98
		651	9270	2000	87	87	98
				AVERAGE	*83*	*88*	*98*
C	Supplement 2	659	8979	2000	91	95	99
		666	8882	2000	92	97	100
		668	8077	2000	85	97	88
				AVERAGE	*89*	*96*	*96*
D	MIL-L-2104A (Polymeric)	660	12373	2000	66	87	97
		662	12074	2000	75	86	96
		657	11596	2000	77	85	95
				AVERAGE	*73*	*86*	*96*
C	Supplement 2	652	10869	*10254	79	97	100
		648	12539	* 7280	83	94	100
				AVERAGE	*81*	*96*	*100*

*Oil drain period based upon electron microscopy.

For Lubricant D (the oil containing the polymeric detergent) the cleanliness rating was only slightly better than that of the non-detergent oil, and below that of the other detergent oils. This was somewhat surprising since the electron micrographs had indicated that the cleanliness rating of Lubricant D should be comparable to that of Lubricant C. One explanation of this might be that oils containing a polymeric detergent, although possessing good detergent action, might have a greater tendency to *form* sludge than conventional detergent oils. This suggests that other factors may have to be considered in judging the suitability of lubricating oils containing polymeric detergents.

It should be mentioned that the engines in this test were equipped with oil filters. Since the filters eventually take out the larger particles and aggregates, the evaluation of the oils must be made on the basis of the finer particles only. It seems reasonable that the use of a filter favors the non-detergent and low-detergent oils, and hence, in this test program, these oils rate more favorably than they would without an oil filter.

As noted earlier, the objective of Part II of the program was to determine whether or not satisfactory engine operation could be achieved with oil drain periods based upon electron microscopic examination. Lubricant C was used for this part of the test. Fig. 8 shows electron micrographs of the whole and supernatant oils at the beginning of the test (at the top) and after 7000 miles of car operation with no oil change (in the center). At this mileage, the oil is losing its ability to disperse solid material well, and the particles are beginning to agglomerate. The oil does, however, still hold a considerable amount of solid material in suspension upon standing, but since one of the necessary requirements is not met it was judged that the oil should be changed. Tht micrographs at the bottom of Fig. 8 show the oil at approximately 1000 miles after the change; it is clearly evident that a satisfactory level of detergency has been re-established by the oil change.

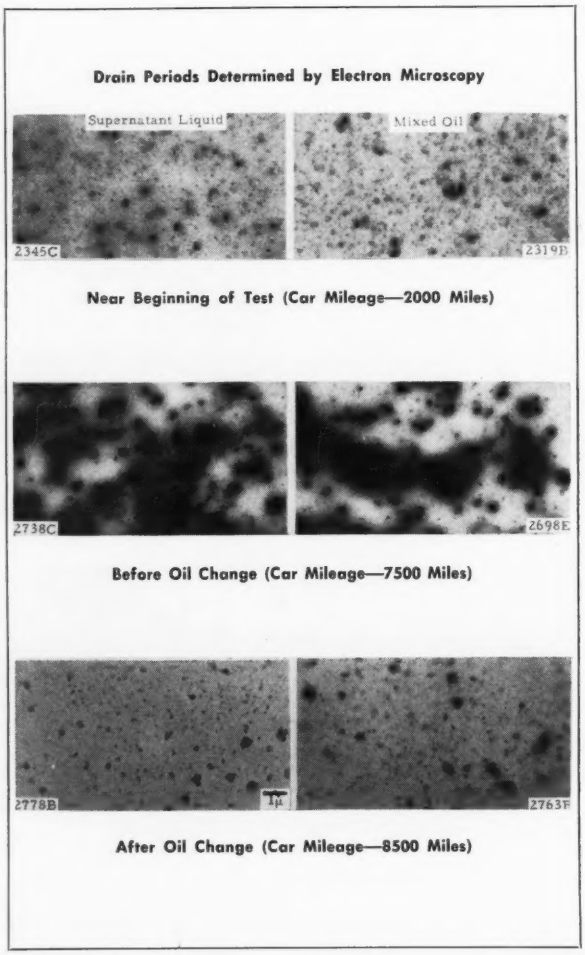

Fig. 8 ELECTRON MICROGRAPHS OF LUBRICANT C (Supp. 2 Level)

As the mileage is further increased, the results are as shown in Fig. 9. Here, 4000 miles of operation later, the solids are not well dispersed; neither are they held in suspension upon standing. Thus it appears that after only about 5000 miles of additional operation the oils should be changed again. For the first change the interval was 7000 miles. These results support the conclusion reached in Part I—namely, that with increasing mileage, the detergency requirement of an engine increases.

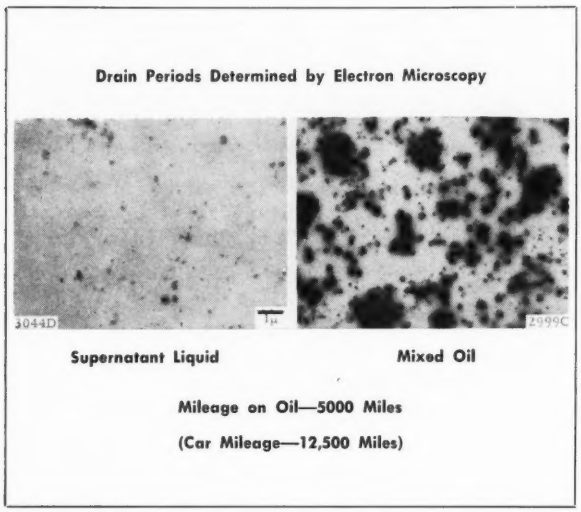

Fig. 9. ELECTRON MICROGRAPHS OF LUBRICANT C (Supp. 2 Level)

Referring again to Table 2, and considering only those cars using Lubricant C, it can be seen that the sludge rating of the cars with the drain periods determined by electron microscopy is lower than that for those cars with the scheduled (2000-mile) drain periods (81 vs. 89). This, of course, might be expected, but considering the fact that the cars with the non-scheduled drain periods were driven approximately one and one-half times farther it is surprising that the difference in sludge rating is not greater. Furthermore, the oil drain periods determined by electron microscopy (non-scheduled) were nearly four times that normally used and yet, from the standpoint of sludge formation, the engines are in nearly as good condition.

When all the cars in the test are considered, and the sludge, varnish and rust ratings are averaged, the cars with the drain periods determined by electron microscopy are better than any other group except one, even though the oil change interval was almost four times the normal interval. Only those cars using Lubricant C on a 2000-mile drain period had a better overall rating.

Another obvious comparison is one between the set of cars operated on drain periods determined by electron microscopy and a set operated without an oil change for the duration of the test. This comparison was, in fact, made. However, due to the fact that the test was terminated before a sufficient number of miles could be accumulated, the cleanliness ratings of the two groups were not significantly different.

CONCLUSIONS

It is recognized by the authors that these tests were made under a specific type of service condition. It is also recognized that detergency is not the sole criterion for judging the oil drain interval. However, within these limitations the following conclusions may be drawn:

1. Confirming the results of previous low-duty tests, the effective detergency level in used, detergent lubricating oils can be determined by electron microscopy and, therefore, drain intervals can be selected that will maintain a clean engine with a minimum number of oil changes.
2. The detergency requirement of an engine increases with increasing engine mileage (detergency requirement is defined as that detergency level needed in an engine, at a particular mileage, to give a satisfactory dispersion of the accumulated solids).

If additional tests of this type were conducted, it would be worthwhile to allow more frequent oil changes by using an oil of lower detergency level, or to run tests of longer duration. Also, in order to obtain a more indicative sludge rating in a reasonable number of test miles, further tests should be run without oil filters to allow a more accurate evaluation of the oils of low detergency level.

ACKNOWLEDGMENTS

The authors wish to acknowledge the assistance and cooperation of the Fuels and Lubricants Department of the General Motors Research Laboratories who made this project possible. In particular, they wish to thank Mr. Norman A. Hunstad and Mr. George K. Malone of that department for their able assistance and advice.

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Nitroparaffine Inhibitors for Cutting Fluids

by E. O. Bennett and H. N. Futch
University of Houston

Several hundred nitroparaffin derivatives have been studied for their antimicrobial activity in a metal cutting fluid. Sixteen compounds were found to be inhibitory for bacteria in the product.

This paper deals with an extensive study of these sixteen inhibitors in six different major products against pseudomonads and sulfate-reducing bacteria. The results show that tris (hydroxymethyl) nitromethane, 2-nitro-2-ethyl-1,3-propanediol dipropionate, 2-bromo-2-nitropropyl acetate, and 2-nitro-2-ethyl-1,3-propanediol exhibited superior activity against both the aerobic and anaerobic bacteria commonly found in metal cutting fluids. These compounds are cheap, relatively nontoxic, and readily soluble in the various cutting fluids, and they appear to have considerable potential use in other types of industrial deterioration problems.

During the past few years a great deal of effort has been expended in an attempt to find bacterial inhibitors for use in metal cutting fluids. One of the most effective compounds to be found so far is tris (hydroxymethyl) nitromethane. Several years ago Wheeler and Bennett (4) observed that this compound was very effective in controlling the growth of bacteria in emulsions, and since that time this compound has created considerable interest in the metal working industry.

During the past two years, several hundred additional nitroparaffin derivatives have been studied in this laboratory for their ability to inhibit bacteria in soluble oil cutting fluids. The objective of this investigation was to compare the effectiveness of a selected group of these compounds with the inhibitory activity of tris (hydroxymethyl) nitromethane. In order to make the study of practical value, the inhibitors were studied in six different major cutting fluid products against both aerobic and sulfate-reducing bacteria.

MATERIALS AND METHODS

The testing units consisted of wide-mouth mason jars containing 600.0 ml. of a commercial cutting fluid mixed with water in a ratio of one part fluid to 25 parts water. Each cutting fluid was especially prepared by the various companies and contained no bacterial inhibitors. The individual nitroparaffin derivatives were added to each unit in a concentration of 1000 ppm. Each unit was inoculated with 1.0 ml. of inoculum which consisted of a mixed heterogenous flora of aerobic bacteria which had been grown in cutting fluids for a considerable period of time. Aeration and continuous mixing of the emulsion was accomplished by bubbling compressed air into the emulsion at all times. Water was added to each unit at periodic intervals to replace water lost by evaporation.

Duplicate standard plate counts were made once each week using sterile distilled water for dilutions and tryptone-glucose yeast agar for cultivation of the aerobic bacteria. The plates were incubated for 48 hours at 37 C. before they were counted. After each sample was taken, the coolants were reinoculated with 1.0 ml. of bacteria each week.

The sensitivity of the sulfate-reducing bacteria to these inhibitors was determined by using the following technique. At the time the plate counts were made, 8.0 ml. of the cutting fluid was pipetted into sterile screw cap test tubes containing 2.0 ml. of a medium with the following composition:

$MgSo_4$	1.0 gm.
K_2HPO_4	1.0 gm.
$(NH4)_2SO_4$	0.1 gm.
Na_2SO_3	0.1 gm.
Ascorbic acid	0.1 gm.
Calcium lactate	3.5 gms.
Peptone	1.0 gm.
Yeast extract	1.0 gm.
Agar	3.0 gms.
Water	200.0 ml.

TABLE 1. EFFECTIVENESS OF NITROPARAFFINS AS BACTERICIDES

(the numbers represent the number of days during which bacterial growth was completely inhibited)

TRIS (HYDROXYMETHYL) NITROMETHANE			FORMALDEHYDE		2-AMINO-1-BUTANOL		2-NITRO-2-METHYL-1, 3-PROPANEDIOL	
PRODUCT NUMBER	AEROBIC BACTERIA	SULFATE REDUCING BACTERIA	AEROBIC BACTERIA	SULFATE REDUCING BACTERIA	AEROBIC BACTERIA	SULFATE REDUCING BACTERIA	AEROBIC BACTERIA	SULFATE REDUCING BACTERIA
1	53	53	15	7	22	0	66	59
2	53	39	29	22	0	0	59	53
3	73	73	36	29	29	0	53	39
4	53	59	7	35	29	0	53	39
5	73	73	29	29	29	7	53	59
6	66	96	78	96	78	96	81	162
2-NITRO-2-METHYL-1-PROPANOL			2-NITRO-1-BUTANOL		N-(2-NITROISOBUTYL) ISOPROPYLAMINE		5-NITRO-2, 2, 5-TRIMETHYL-3-AZA-1-HEXANOL	
PRODUCT NUMBER	AEROBIC BACTERIA	SULFATE REDUCING BACTERIA	AEROBIC BACTERIA	SULFATE REDUCING BACTERIA	AEROBIC BACTERIA	SULFATE REDUCING BACTERIA	AEROBIC BACTERIA	SULFATE REDUCING BACTERIA
1	31	24	71	15	15	15	24	10
2	7	7	0	15	22	15	24	24
3	24	10	78	71	51	29	46	31
4	7	7	51	65	7	15	24	10
5	24	10	7	15	29	29	10	10
6	46	53	85	106	44	58	31	68
2 NITRO-1-PHENYL-1-PROPENE			2 NITRO-2-ETHYL-1, 3 PROPANEDIUL PIPROPIONATE		1-METHOXY-2-NITRO-1-PHENYLPROPANE		2-NITRO-1-PROPYL ACETATE	
PRODUCT NUMBER	AEROBIC BACTERIA	SULFATE REDUCING BACTERIA	AEROBIC BACTERIA	SULFATE REDUCING BACTERIA	AEROBIC BACTERIA	SULFATE REDUCING BACTERIA	AEROBIC BACTERIA	SULFATE REDUCING BACTERIA
1	51	36	29	44	0	0	40	25
2	44	36	71	64	0	0	40	7
3	51	29	78	64	58	0	18	0
4	29	29	96	120	0	0	47	0
5	44	36	64	64	29	29	53	7
6	44	44	86	106	51	65	47	47
2 NITRO-1-BUTYL ACETATE			2-BROMO-2-NITROPROPYL ACETATE		1-BROMO-1-NITRO-PROPANE		2-NITRO-2-ETHYL-1, 3 PROPANEDIOL	
PRODUCT NUMBER	AEROBIC BACTERIA	SULFATE REDUCING BACTERIA	AEROBIC BACTERIA	SULFATE REDUCING BACTERIA	AEROBIC BACTERIA	SULFATE REDUCING BACTERIA	AREOBIC BACTERIA	SULFATE REDUCING BACTERIA
1	44	7	86	67	25	18	73	66
2	15	0	53	25	11	7	53	46
3	22	15	75	33	25	0	81	59
4	51	15	94	53	11	7	59	53
5	36	36	75	96	18	11	66	53
6	64	71	60	60	7	7	92	101

Each tube was inoculated with 0.5 ml. of a 3 day old pure culture of *Desulfovibrio desulfuricans* that had been grown in M-10-E medium(2). The tubes were incubated at 30C for one week and then the effectiveness of the inhibitor was determined by studying the tubes for the presence of hydrogen sulfide and iron sulfide. It may be noted that the procedure reduced the concentration of the inhibitor by 20 per cent.

The results in the tables are based on complete inhibition of all microbial growth.

RESULTS

Sixteen nitroparaffins were studied for their ability to inhibit microbial growth in metal cutting fluids. The results show that tris (hydroxymethyl) nitromethane, 2-nitro-2-ethyl-1,3-propanediol dipropionate, 2-bromo-2-nitropropyl acetate and 2-nitro-2-ethyl-1, 3-propanediol exhibited superior activity against both the aerobic and anaerobic flora commonly found in these products.

The results clearly show the difference in effectiveness of any given inhibitor in different cutting fluid products. For example, 2-nitro-1-butanol was very effective in inhibiting the growth of aerobic bacteria in four products; however, this compound produced very little inhibitory activity in the other coolants.

DISCUSSION

The nitroparaffins and their derivatives comprise one of the most interesting groups of new bacterial inhibitors that have been discovered in recent years. These compounds are cheap, relatively nontoxic, and readily soluble in the various cutting fluids. It also appears that these compounds may have considerable potential use in other types of deterioration problems.

The nature of previous studies pertaining to inhibitors for cutting fluids makes it impossible to compare the activity of other inhibitors with the nitroparaffins. Pivnick and Fabian (3) studied the inhibitory activity of their compounds for a total of only 44 days while Wheeler and Bennett (4) and Bennett (1) study the effectiveness of their inhibitors for 60 days. In addition, none of these workers investigated the effectiveness of their inhibitors against sulfate-reducing bacteria. The present investigation is the first study in which the inhibitory activity of a compound was determined against both the aerobic and sulfate-reducing bacteria for the total length of effectiveness of the compound. Tests in this laboratory indicate that some of the nitroparaffins are superior to over 100 phenolic compounds studied in the course of our investigations.

The inhibitory activity of tris (hydroxymethyl) nitromethane is believed to be in part due to the ability of the compound to slowly release formaldehyde in an alkaline environment. The release of formaldehyde under these conditions makes it difficult to incorporate the compound into cutting fluid concentrates. Some of the compounds such as 2-bromo-2-nitropropyl acetate do not release formaldehyde and it is possible they can be more readily added to the undiluted product by the manufacturers of these coolants.

It should be pointed out that each unit was reinoculated each week with a mixture of bacteria. This technique is different from that used by Wheeler and Bennett (4). It appears that this procedure tests the inhibitor much more effectively than a single inoculum at the beginning of the experiment. For example, when a single inoculum at the beginning of the experiment was used, 2-nitro-1-butanol was completely inhibitory for 101 days in a concentration of 500 ppm. When the units were inoculated with fresh inoculum once each week the same compound was effective for 78 days in a concentration of 1000 ppm.

It must be remembered that the nitroparaffins are new inhibitory agents and very little information is available yet pertaining to the factors that can influence their antimicrobial activity. Indiscriminate use of these highly effective compounds may drastically reduce or eliminate their antibacterial activity.

ACKNOWLEDGMENTS

The research reported above was supported by a grant from Commercial Solvents Corporation of Terre Haute, Indiana. The authors would like to thank Dr. E. B. Hodge of Commercial Solvents Corporation for supplying the nitroparaffin compounds and the various cutting fluid manufacturers for kindly furnishing special samples of their products for use in this investigation.

SUMMARY

Sixteen nitroparaffin compounds were studied for their inhibitory activity against aerobic and sulfate-reducing bacteria commonly encountered in cutting fluids. It was found that four compounds were outstanding inhibitors for these products.

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3. Pivnick, H., and F. W. Fabian, *Applied Microbiology*, Vol. 1, 1953, pp. 204–207.
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GREATER RUN-IN PROTECTION EXTENDS PISTON LIFE OF CURTISS-WRIGHT ENGINES

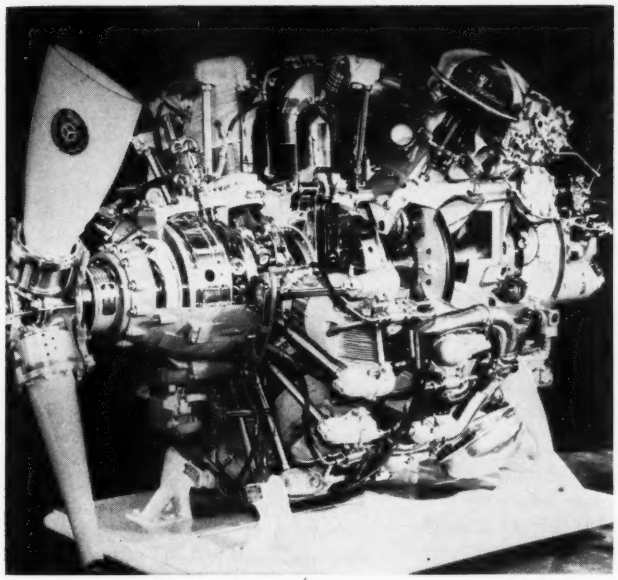

Photo courtesy of Curtiss-Wright Corp.

Curtiss-Wright Corporation's Wright Aeronautical Division, located at Wood-Ridge, N.J., has extended the "life span" of pistons used in their radial reciprocating airplane engines. By coating piston skirts with 'dag' 213 — a dispersion of graphite in an epoxy-resin binder — they are protected against scuffing, scoring, galling, and seizing during the critical running-in period.

Where previously Curtiss-Wright engineers had used finely powdered graphite and phenolic resin, they found that 'dag' 213 was more uniform in consistency and had better adhesion . . . was actually adsorbed by the surface to form a more durable, corrosion-resistant film that became virtually integral with the metal. Due to the heat-transmission properties of 'dag' 213, the coefficient of friction is kept at a uniform minimum to assure free action and proper wear-in characteristics. The exacting clearances in reciprocating engine design make the run-in process so critical that perfect friction and heat control must be maintained under the speeds and loads required. In addition, the graphoid surface takes over the job of supporting the load if the liquid lubricant ruptures momentarily during run-in, thereby preventing metal-to-metal contact until the oil film re-establishes itself.

'dag' 213 is spray-applied at Curtiss-Wright with conventional spray equipment. After the piston skirts are coated, the preassembled pistons are oven-heated at 350°F for 2½ to 3 hours. Fabrication and treatment techniques used at Curtiss-Wright permit a high degree of accuracy in maintaining piston and cylinder wall tolerances. Only forged aluminum alloys are used for these pistons which operate within nitrided steel cylinder walls. The application of Acheson's 'dag' 213 has been extended to all models of Curtiss-Wright engines in both their 18 and 9-cylinder categories. Investigate the use of an Acheson Dispersion in your own assembly or run-in application. Write Dept. LE-50.

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2. Permit closer tolerances due to their microscopic, flat particle size.
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4. Lower bearing temperatures.
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Patent Abstracts

Compiled by Ann Burchick
Aluminum Co. of America

Ureido Thickened Greases, Patent, #2,832,739 (E. A. Swakon, assignor to Standard Oil Co.) A lubricant grease comprising a lubricant vehicle thickened with from about two per cent to about 50 per cent, by weight, of at least one ureido compound.

Water-Resistant Alkali Metal and Alkaline Earth Metal-Containing Grease, Patent #2,831,812 (H. J. Worth, assignor to Union Oil Co. of California) A water-resistant grease prepared by reacting a mixture of mineral lubricating oil and alkaline earth metal soap of fatty acids containing at least about 90 per cent by weight of saturated high molecular weight fatty acids with an aqueous solution of between about one and about two equivalents, per equivalent of alkaline earth metal soap, of a compound selected from the class consisting of alkali metal hydroxides and carbonates and heating the resulting mixture to remove water.

Application of Solid Lubricant Coatings to Surfaces, Patent #2,902,417 (J. E. Brophy and R. W. Ingraham, assignors to International Business Machines Corp.) The method of applying to a surface of a member composed of an alloy selected from the group consisting of steel, copper-base alloys and aluminum-base alloys, an adherent coating of a solid lubricant of a metallic compound selected from the group consisting of sulphides, selenides and tellurides of tungsten and molybdenum, comprising electroplating the surface of the member to deposit thereon an adherent electroplate of the metal component of the compound and then subjecting the electroplated surface to a converting gas consisting of at least one of the group consisting of sulphide, selenide and telluride gases at a pressure ranging from in excess of atmospheric pressure to about 400 psi and at a temperature range of from approximately 60 C. to about 125 C. for a period of from 30 hours to 110 hours depending upon the thickness desired of the metallic compound coating being formed on the surface of the member.

Reclamation of Aluminum Fabricating Lubricants, Patent #2,902,439 (W. C. Milz and W. M. McClintock, assignors to Aluminum Co. of America). In the reclamation of hydrocarbonaceous lubricants utilized in the fabrication of aluminum and aluminum base alloy articles and contaminated with aluminum particles, the method comprising: admixing with said lubricant an aqueous cleaning solution containing essentially sodium aluminate and at least an equal weight of sodium hydroxide; agitating the admixture at a temperature of 120 to 210 F. until a color change occurs; and thereafter separating the aqueous cleaning solution containing said contaminants.

Aqueous Lubricant Composition, Patent #2,902,449 (K. Hopfner and E. Gotte, assignors to Dehydag, Deutsche Hydrierwerke G.m.b.H.) An aqueous emulsion for lubricating metal parts in machining and non-cutting shaping operations comprising an aqueous dispersion of from about 0.05%–20% by weight of said emulsion of a neutral salt prepared by reacting equimolar amounts of (1) a water soluble salt of an organic sulfur containing acid selected from the group consisting of alkyl substituted sulfuric acid and alkyl substituted benzene sulfonic acids in which the alkyl radical contains at least 10 carbon atoms and not more than 18 carbon atoms and (2) a quaternary ammonium soluble salt of an inorganic acid in which the pentavalent nitrogen atom of said salt is substituted with at least one alkyl radical containing from 10 to 22 carbon atoms whereby the inorganic anion of said salt is replaced by the anion of said organic sulfur containing acid in said dispersion.

Lubricating Oil Composition, Patent #2,902,450 (W. Lowe, assignor to California Research Corp.) A lubricant composition consisting essentially of a major portion of a mineral lubricating oil for internal combustion engines containing minor amounts of basic alkaline earth metal petroleum sulfonate and basic sulfurized alkaline earth metal alkyl phenate which is normally corrosive to alloy bearings and a minor portion, sufficient to inhibit corrosion of a p-xylylenediamine salt of a diglycol boric acid in which the glycol groups are identical α– and β–glycol groups containing from 6 to 10 carbon atoms in each glycol group.

New Chemical Compounds and Mineral Oil Compositions Containing the Same, Patent #2,902,499 (R. I. Gottshall and R. T. Kern, Jr., assignors to Gulf Oil Corp.) A material selected from the group consisting of (I) acidic condensation products of (a) a dimeric acid derived from an ethenoic fatty acid that contains 2 to 3 ethylenic linkages and 6 to 22 carbon atoms per molecule, and (b) a member selected from the group consisting of maleic acid and maleic anhydride, where the mol ratio of (a) to (b) is 1:1 to 1:2 when the dimeric acid is derived from a dienoic acid and 1:1 to 1:3 when the dimeric acid is derived from a trienoic acid and (II) organic derivatives of said acidic condensation products selected from the group consisting of amine salts and amides of aliphatic monoamines that contain 8 to 22 carbon atoms per molecule and whose substituents are hydrocarbon radicals, and esters of unsubstituted monohydric alcohols that contain 8 to 22 carbon atoms per molecule.

Paraffin Wax Composition of Improved Gloss Stability, Patent #2,903,408 (H. C. Moyer, assignor to Sinclair Refining Co.) A composition consisting essentially of a crystalline petroleum wax and a small but effective amount of a fraction of

petrolatum characterized by a molecular weight of about 800 to 1100, an API gravity of about 27 to 31 degrees and a pour point of about 60 to 85 F. to improve the gloss stability of the crystalline wax, the highest melting point 10% cut of said petrolatum having a melting point not above about 95 F.

Lubricants Containing Comminuted Fluid Coke, Patent #2,903,426 (A. J. Morway and W. J. Sweeney, assignors to Esso Research & Engineering Co.) A lubricant consisting essentially of a major proportion of a mineral lubricating oil and 4 to 40 wt. percent of "fluid coke" having a maximum particle size under 200 mesh (Tyler).

Lubricating Grease Compositions, Patent #2,903,427 (P. Bidault and R. Metenier, assignors to Esso Standard Societe Anonyme Francaise) A lubricating grease comprising a major proportion of a lubricating oil, a minor grease making proportion of an alkali-metal soap-base grease-thickener, and containing in the range of 0.1 to 5.0 weight percent of the condensation product of an aromatic amine having in the range of 1 to 3 benzene rings and an alkylene oxide having in the range of 2 to 4 carbon atoms per molecule, said condensation product having a molecular weight in the range of 300 to 5000.

Fire Resistant Hydraulic Fluid and Lubricating Composition, Patent #2,903,428 (D. M. Moreton, assignor to Douglas Aircraft Co., Inc.) The composition consisting essentially of a dialkyl phenyl phosphate wherein the number of carbon atoms in each of the alkyl groups is from 4 to 8 and the total number of carbon atoms in the two alkyl groups is from 8 to 12 and a sufficient proportion within the range of 0.2 to 10 percent by weight of a polyalkyl methacrylate in which the alkyl group has from 4 to 8 carbon atoms, said methacrylate having an average molecular weight of about 8,000 to 12,000 and a molecular-weight range within the range of about 2,000 to 18,000 and being compatible with said dialkyl phenyl phosphate and increasing the viscosity index above 150.

Process for Lubricating Filaments, Patent #2,904,454 (F. Berndt and W. Sonnenschein, assignors to Spinnfaser Aktiengesellschaft) In a process for lubricating artificial filaments after the washing operation following spinning wherein the lubricants are applied to the filaments in a dilute aqueous liquid composition of the lubricants followed by mechanical separation of excess liquid, the improvement which comprises dividing said application of lubricants into two stages, the first said stage comprising the application of said lubricants in a dilute aqueous liquid composition substantially more dilute than the first-mentioned aqueous composition, the second said stage comprising the application of said lubricants in an aqueous liquid composition substantially more concentrated than the first-mentioned aqueous composition, the total amount of said lubricants applied in said first and second stages being substantially equivalent to the amount applied by the first-mentioned aqueous composition, and mechanically separating excess liquid from the filaments solely between said stages, said second stage application being made in a controlled quantity of a composition of sufficient concentration to provide the required amount of lubricants on the filaments without mechanical separation of liquid, the losses of lubricants consequently being reduced owing to their reduced concentration in the liquid losses which accompany said sole mechanical separation between stages.

Wood Preservative Grease, Patent #2,904,467 (E. A. Behr, assignor to Chapman Chemical Co.) A wood preservative composition comprising at least 2% of pentachlorophenol, 50% to 95% of a mineral oil solvent for the pentachlorophenol, and a compound of bentonite and an organic-nitrogen base in an amount sufficient to impart a grease-like consistency to said composition said compound being a compound of bentonite with an organic base of sufficient alkalinity to be titratable with mineral acids, which compound is made by bringing together bentonite and such organic base in the presence of water.

Manufacture of Lubricating Oil, Patent #2,905,624 (W. K. T. Gleim, assignor, by mesne assignments, to Universal Oil Products Co.) A process for the manufacture of lubricating oil which comprises contacting a hydrocarbon oil fraction boiling above about 500 F. and containing condensed ring naphthenes with a desulfurization catalyst in the presence of hydrogen at superatmospheric pressure and at desulfurizing conditions, separating the desulfurized material into a normally liquid and a normally gaseous fraction, passing the normally liquid fraction into contact with a hydrogenation catalyst supported on a non-acidic base in the presence of hydrogen at conditions to cause dehydrogenation of condensed ring naphthenic compounds to aromatics, separating the resultant material into aromatic and nonaromatic fractions and recovering the desired lubricating oil from said nonaromatic fractions.

Method for Producing Very Low Pour Oils from Waxy Oils Having Boiling Ranges of 680-750 F. by Distilling Off Fractions and Solvents Dewaxing Each Fraction, Patent #2,906,688 (M. H. Farmer, J. L. Tiedje and D. M. MacLeod, assignors to Esso Research and Engineering Co.) A process for producing a low pour point oil which comprises distilling a wax-containing petroleum oil, recovering a fraction having a boiling range of less than about 20 F. and having initial and final boiling points within the range between about 680 F. and about 750 F. at atmospheric pressure, dewaxing said fraction at a temperature between about −10 F. and about +30 F. in the presence of a ketone dewaxing solvent, and recovering a dewaxed oil having a pour point at least about 20 F. below the dewaxing temperature.

Lubricant Additive of High Metal Content, Patent #2,906,709 (N. E. Lemmon and F. W. Schuessler, assignors to Standard Oil Co.) In the preparation of a barium containing, oil soluble lubricant additive wherein a butylene polymer is reacted with from about 1% to about 50% of a phosphorus sulfide at a temperature of from about 200 F. to about 600 F. and the resultant reaction product hydrolyzed at a temperature of from about 220 F. to about 500 F., and then extracted at a temperature of from about 100 F. to about 212 F. with from about 10% to about 200% by volume of a mixture consisting of water and from about 5% to about 95% by volume of a hydroxy compound selected from the group consisting of phenol and alkyl alcohols having from one to five carbon atoms, and the extracted reaction product neutralized with a basic barium compound, the improvement comprising neutralizing said extracted reaction product by preparing a reaction mixture of said extracted reaction product, barium hydroxide, phenol and water in a hydrocarbon oil diluent, the barium hydroxide being present in the range of from about 1 to about 10 times the amount necessary to neutralize said extracted reaction product, the phenol being present in sufficient amount to maintain the reaction mixture acidic and the water content being in the range of from about 2% to about 10% based on the total weight of reaction mixture, gradually heating the mixture to about 400 F. while introducing CO_2 thereto in excess of amounts which can be absorbed and steaming the mixture and then filtering the product to obtain a bright high barium containing additive having a low viscosity.

Defoamant Composition, Patent #2,906,712 (R. T. Edwards and E. P. Rittershausen assignors to Socony Mobil Oil Co., Inc.) A composition for suppressing foaming in aqueous media having a pH lower than 7, which comprises between about

(Con't. on page 235)

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Flanges, if desired, are available to simplify positioning and removal

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PATENT ABSTRACTS

(*Con't. from page 233*)

2 and about 50 weight percent aliphatic amine containing between about 8 and about 18 carbon atoms; between about 0.1 and about 0.5 weight percent of a nonionic surface active agent, the weight ratio of said surface active agent to said amine being between about 0.01 and about 0.05; and the balance a mineral oil having a Saybolt Universal viscosity varying between about 30 and about 200 seconds at 100 F.

Lubricating Oil Compositions, Patent #2,905,639 (H. Krzikalla, Hans Engel, Willy Wolf and Heinz Pohlemann, assignors to Badische Anilin- & Soda-Fabrik Aktiengesellschaft) The process of improving mineral lubricating oils which comprises adding to a mineral lubricating oil from about 0.01 to about 5 percent of an oil-soluble compound selected from the group consisting of a 2.5-dimercapto-1.3.4-thiadiazole derivative.

Petroleum Lubricant Stabilized Against Hydrocarbon-Metabolizing Microorganisms, Patent #2,905,640 (E. B. Hodge, assignor to Commerical Solvents Corp.) A petroleum lubricant stabilized against hydrocarbon-metabolizing micro-organisms containing a small but sufficient amount to inhibit said petroleum metabolizing micro-organisms of 5-amino-2, 2, 5-trimethyl-3-aza-1-hexanol.

Method for Color Improvement of Polymeric Pour Point Depressors, Patent #2,906,729 (A. H. Popkin, assignor to Esso Research & Engineering Co.) A process for the improvement of the color and odor of lubricating oil additives which are copolymers of (A) alpha-beta ethylenically unsaturated dicarboxylic acid neutral esters of saturated monohydric alcohols with (B) low molecular weight neutral vinyl esters, wherein said copolymers had been copolymerized in the presence of a strong acid and a peroxide catalyst which comprises, contacting said copolymers with a minor but color stabilizing amount within the range of 0.1 to 5.0 wt. percent, based on the weight of said copolymers of a basic nitrogen-containing neutralizing agent selected from the group consisting of ammonia and amines.

Lubricating Oil Composition, Patent #2,907,713 (N. E. Lemmon and E. K. Fields, assignors to Standard Oil Co.) A lubricant composition having improved anti-rust and detergency properties comprising a major proportion of a lubricating oil and in combination therewith a minor proportion, from about 0.001% to about 10% by weight, of the product obtained by reacting at a temperature of from about 180 F. to about 280 F., from about 80% to about 99% by weight, of a neutralized, metal-containing phosphorus sulfide-olefin hydrocarbon reaction product and from about 1% to about 20% by weight of an organic amine compound selected from the class consisting of an aliphatic hydrocarbon amine, an aromatic hydrocarbon amine and a heterocyclic amine having from about 4 to about 9 carbon atoms in the heterocyclic ring, said neutralized, metal-containing phosphorus sulfide-olefin hydrocarbon reaction product being obtained by reacting from about 15 to about 50% by weight phosphorus sulfide with an olefin hydrocarbon at a temperature from about 200 F. to about 500 F. and neutralizing the resulting product with a basic compound of a metal selected from the group consisting of alkali metals and alkaline earth metals.

(*Con't. on page 236*)

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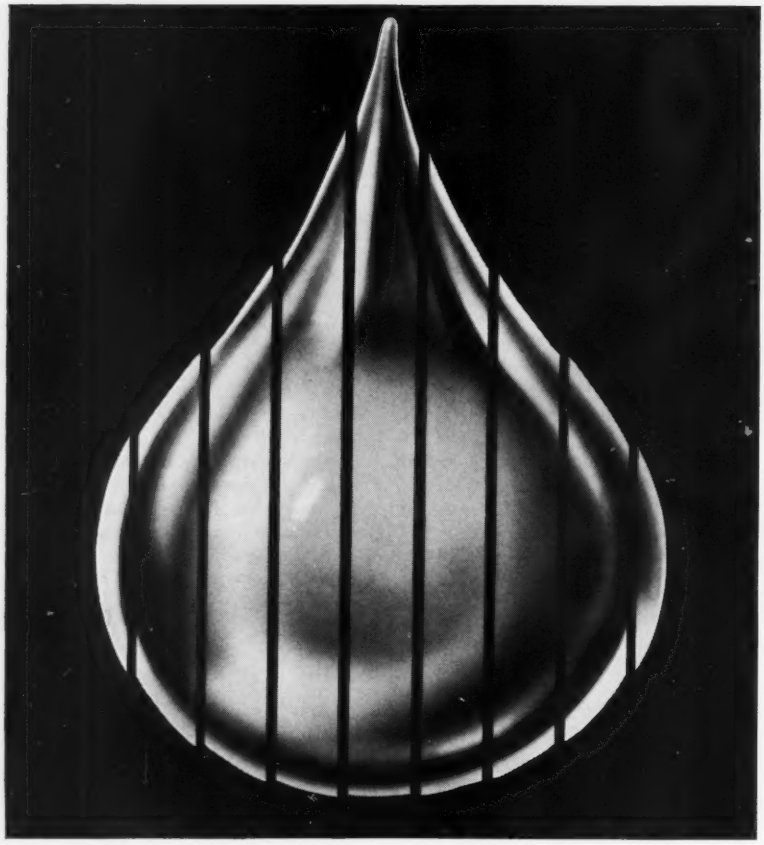

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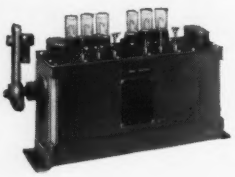

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PATENT ABSTRACTS

(*Con't. from page 235*)

Method for Stabilizing Lubricating Oil, Patent #2,908,638 (J. Van Dyck Fear, assignor to Sun Oil Co.) A process for the production of stable oils of lubricating viscosity which comprises treating a petroleum fraction of lubricating viscosity with anhydrous sulfur trioxide, whereby to form sulfonic acids, separating sulfonic acids from the treated petroleum fraction, contacting the treated fraction with hydrogen, in the presence of a sulfur resistant hydrogenation catalyst, at a pressure of from about 150 p.s.i.g. to about 300 p.s.i.g. and at a temperature of from about 450 F. to about 700 F., but below the temperature at which appreciable dehydrogenation of naphthenes to aromatics or hydrocracking will take place at the pressure used, and recovering an oil which will not discolor on heating to a temperature in excess of 400 F.

Lubricating Greases Thickened with Metal Salts of Sulfonated Hydroxy Azo Compounds, Patent #2,908,644 (N. R. Odell and J. F. Lyons, assignors to Texaco Inc.) A lubricating grease consisting essentially of a lubricating oil thickened to a grease consistency with a high melting monoazo compound selected from the class consisting of polyvalent metal salts of sulfonated benzene-azo-naphthol compounds and naphthalene-azo-naphthol compounds containing 1–3 polyvalent metal sulfonate groups, and substituted derivatives of such compounds wherein the substituent groups are substantially neutral non-oil solubilizing groups.

Lubricating Greases Containing Polymerized Dihydroquinolines, Patent #2,908,646 (J. R. Roach and J. P. Dilworth, assignors to Texaco Inc.) A lubricating grease consisting essentially of a mineral lubricating oil containing sodium myristate in grease forming proportions and about 0.1–10 percent by weight of polymer.

Water-in-Oil Lubricant and Hydraulic Fluid, Patent #2,907,714 (C. E. Francis and J. J. Weaver, assignors to Shell Development Co.) A water-in-oil emulsion lubricant and hydraulic fluid which is from about 20% to about 45% water phase and from about 55% to about 80% oil phase, the oil phase being essentially a mineral oil containing from about 0.5% to about 12% each, based on the oil, of an oil-soluble basic alkaline earth metal organic sulfonate and an oil-soluble basic alkaline earth metal alkyl salicylate from about 3% to about 10% of an oil-soluble chlorine-containing naphtha xanthate.

The TUTHILL Internal Gear Pump . . . and its advantages in reversing applications

by E. H. Schanzlin,
Chief Engr., Tuthill Pump Co.

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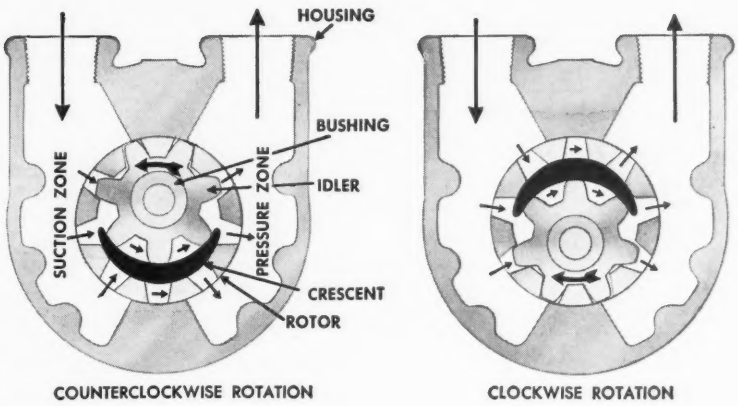

How It Operates

Key elements are the rotor, idler gear and the crescent shaped partition. This crescent shaped partition, shown in heavy black, is cast integral with a moving part called the idler carrier.

In the drawing at left, power is applied in counterclockwise rotation to the rotor and transmitted to the idler gear with which it meshes. The space between the outside diameter of the idler and the rotor is sealed by the crescent. When the pump is started, there is an increase in volume as the teeth come out of mesh. This creates a partial vacuum, drawing the liquid into the pump through the suction port. The liquid fills the spaces between the teeth of the idler and rotor and is carried past the crescent to the pressure side of the pump. When the teeth mesh on the pressure side the liquid is forced from the spaces and out through the discharge port.

When shaft rotation is changed from counterclockwise to clockwise, as in the drawing at right above, the idler carrier, (including the idler gear and crescent) automatically rotates 180° through the suction zone. This changes the directional flow within the pump without changing port positions. The idler carrier rotates in a cover casting fitted with stops so that the crescent can rotate only 180° —always through the suction zone. If rotation were again reversed to counterclockwise, the crescent would swing back to its original position (shown at left above).

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Lubrication Abstracts

Edited by W. E. Campbell

Selected literature compiled by members of the Technical Committees and Industry Councils of the Society.

Heinz Rettig, and Gisbert Lechner, "On the Testing of Lubricants in the Gear Rig. State of the Art." Gustav Niemann (Technisches Hochschule München, Munich, 2, Germany.), Erdöl u. Kohle. In German. v. 12, no. 6, 1959, pp. 472-80.

There are in W. Germany about 20 test stands for evaluation of scuffing and wear resistance of oils by the procedure of the FZG test, which appears to be in general use for automotive oils. The machine used is similar to the (English) IAE machine but has gears of 16 and 24 teeth, with long and short addendum teeth. The load is applied with the gears stationary. The test is run in 15-min steps, after each of which the machine is stopped and the test gears are removed, washed, and weighed. The wear rate is calculated in milligrams per HP-hour (cumulative) transmitted by the gears. The load is increased for the next run, and contrary to USA practice, the load increments are successively larger. A sudden increase in the wear rate signals the end point of the test.

The test is used, inter alia, for 1) The development and choice of lubricants with regard to scuff load and wear prevention, e.g. for rear axle and gear oils in trucks, for run-in oils, for oils for hydraulic drives involving gears, and for highly loaded fast-running drives in heavy machines; 2) To insure the unchanging performance of a lubricant, e.g. during changeover to quantity production of a newly-developed oil, change to other additives, and in large drives (such as ship drives) after a long running time in the machine; 3) For compliance with delivery specifications; etc. Non-standard tests are also run, employing various gear tooth forms, helical gears, higher speed, narrower gears, etc., to impose special conditions.

Repeatability is said to be within 'one load step', which makes it about like the Ryder or IAE test, i.e. not better than $\pm 10\%$. Each batch of test gears (not less than 200 pieces) is checked for load-limit by a test run on a reference oil.

Good qualitative correlation with actual machines is claimed, but data are admitted to be too scanty for accurate prediction of quantitative performance. Six oils were tested on the FZG, IAE, and Ryder machines, and were ranked in the same order by all three machines. Tip relieved gears were used only in the IAE machine. Rear axle tests are considered cumbersome and inaccurate, and it is stated that 4-ball tests do not rank oils in the same order as gear tests. (*Abstractor: E. A. Ryder*)

J. C. Wood—Mallock, H. Weiner, and L. G. Wood (Manchester Oil Ref., Ltd.), "The Effect of Metals on Transformer Oils and Some Methods of Protection Against Adverse Effect," Inst. Petroleum J. v. 44, no. 418, 1958, 320-32.

The copper content of fifty-six samples of transformer oil from small distribution transformers is found to range from 0.2 to 0.6 ppm with a few samples having contents up to 6 ppm. The solubility of copper in a number of transformer oils prepared from different crudes and/or by different methods is studied. It is found that copper concentrations of up to 1.5 to 2.0 ppm can be obtained in the laboratory at temperatures of 70 to 80°C in 40 to 120 hrs. The effect of chelating agents, and combination of chelating agents and oxidation inhibitors on the solubility of copper in these oils and on their oxidation characteristics is investigated. Salicylic acid derivatives and 8-hydroxyquinoline, both of which form very stable copper complexes, produce the greatest increases in copper solubility. Amino acids and diamines do not show this effect. Combination of oxidation inhibitors and chelating agents of the aromatic amino acid-diamine type are found to radically suppress the solubility of copper. The combinations of anthranilic acid with phenol β-naphthylamine or with butyl-para-cresol show good results in a number of different oils and in several of the accelerated tests. Oils containing chelating agents, passivated oils, prepared from base oils with good response to passivation show significantly better oxidation characteristics than inhibited oils made from base oils having a good response to oxidation inhibitors. (*Abstractor: E. O. Forster*)

Staff Writer, "Heat Coolant to Hold Tolerances," (Pratt & Whitney Aircraft, North Haven, Conn.) *American Machinist*, v. 102, no. 14, 1958, 88.

Coolant 10 to 15°F. below ambient can shrink work pieces more than .0005" tolerance. Many factors influence coolant temperature, so it is controlled by heating with a 6 Kw chromalox heater of 20 watts/sq. in. in coolant supply line between tank and grinder head. With coolant temperature controller set at 2°F. higher than pyrometer-checked master gage temperature, work pieces regaged after 48 hours are within .0001" of original gage reading. (*Abstractor: N. C. Morrell*)

W. H. L. Hooper, "New Metals in the Oil Industry," pt. 1, *Petroleum* (London) v. 11, no. 7, 1958, 219-24.

Four of the new metals produced on a commerical scale are outstanding for their corrosion resistance. They are titanium, zirconium, tantalum, and niobium. Properties of these metals are reviewed and welding, forming and working discussed. (*Abstractor: R. McKay*)

G. W. Rowe, "Molybdenum Disilicide for High Temperature Sliding," *Engineer*, v. 206, no. 5357, 1958, p. 487.

Experiments are conducted with sintered $MoSi_2$ bars and with $MoSi_2$ coatings formed on pure molybdenum by vapor deposition. $MoSi_2$ was selected in the belief that this compound is less prone to oxidation than the customarily used MoS_2. For the $MoSi_2$ bars the coefficient of friction is found to be 0.7 while that for the coated specimen ranged from 0.62 to 0.8 depending on the finishing treatment. Upon heating the samples in air the bars showed no change in the coefficient of friction up to 900°C while the coated specimen increased in friction at 700°C. These experiments suggest that $MoSi_2$ does not in itself seize durin sliding at high temperatures, but maintains a steady though rather high friction. The anti-seizure properties of these coatings together with their oxidation resistance may be valuable for using parts inside furnaces and for hot-working tools. (*Abstractor: E. O. Forster*)

D. Firth (Mechanical Engineering Research Laboratory, East Kilbride, Glasgow) and J. Kane, Engineer, "Measurement of the Air Content of Hydraulic Oils and Similar Fluids," v. 206, no. 5632, 1958, p. 679-80.

A test device which is designed to measure the total gas content of oils and similar fluids is described. It is reported to be simpler and more rugged than existing instruments. Results on non-foaming fluids are compared with those from the M.E.R.L. version of the Van Slyke apparatus. (*Abstractor: M. I. Smith*)

(*Con't. on page 240*)

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LUBRICATION ABSTRACTS

(Con't. from p. 238)

N. F. Rieger, (Univ. Nottingham), "An Experimental Investigation on the Pressurised Air-Lubricated Journal Bearings in the High-speed Range," *Scientific Lubrication* (London), v. 11, no. 1, 1959, 10.

An experimental apparatus is described for studying the friction characteristics of externally-pressurized air-lubricated journal bearings. The apparatus has 1.25 × 1-0.375 in. diameter plain cylindrical bushes, and compressed air is admitted through three sets of radial-inlet holes around the bush circumference, pressures being adjusted to keep the shaft and bush as close to concentric as possible. Effects of variations in speed, load, diametrical clearance, and inlet pressure over a wide range at high speeds are discussed. Experimental friction coefficients are compared with those given by the Petroff formula, and some correlation is obtained. (*Abstractor: R. McKay*)

A. A. Milne, "The Effect of Lubricant in the Theory of Hydrodynamic Lubrication," *Scientific Lubrication* (London) v. 11, no. 1, 1959, 31.

In a theoretical study on the corrections required in the basic lubrication equations to allow for small effects of lubricant inertia in laminar flow between inclined planes, the stream function for a wedge-shaped oil film with purely viscous flow is determined and the first-order correction for inertia is then obtained. When the angle between the planes is small, the analysis may be applied to the consideration of inertia effects in a lubricating film, and the reduced expressions may be compared with those obtained by Kahlert. The two methods are essentially similar, but the final agreement is highly satisfactory in view of the considerable differences in detail. In general, the effect of lubricant inertia appears to cause a slight decrease in the load capacity of a bearing. (*Abstractor: R. McKay*)

Staff Writer, "20 Years of Progress in Equipment & Methods—Extruding," *Metal Forming & Fabricating*, v. 21, no. 1, 1959, 21.

A process is described in which steel slug is treated with zinc phosphate in acid solution, then with soap and fatty acids. Extrusion of the part changes a touch porous surface to a hard coating, releasing the lubricant as required. (*Abstractor: N. C. Morrell*)

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1,000 bolts ahead with TRABON —each day!

There's nothing so terrifyingly quiet as a Boltmaker out of action. Yet to lubricate this Boltmaker by hand with its 26 grease points would take at the very minimum 10 minutes. That's equal to the time it takes to produce 1,000 bolts. Repeat this downtime for a month and you're talking big money. That's why you see a Trabon Centralized Lubricating System installed here to prevent lubrication shutdowns from taking place. Trabon delivers a measured amount of clean lubricant to all bearings — no matter where located. Trabon lubricates while the Boltmaker operates . . . eliminating downtime. Trabon saves man hours, bearing repairs, lubricant. No matter how large your machine — no matter how **new or old** — Trabon will help it produce more thus lowering your unit costs. Let us tell you more about how Trabon can improve the performance of your machines.

Digesting heavy wire and ejecting rugged high quality bolts is this National Machinery Boltmaker at an Ohio bolt manufacturing plant. A Trabon Manual Centralized Lubricating System (outlined in white) protects vital grease bearings by keeping them supplied with clean lubricant in exact measured amounts.

Trabon® **Trabon Engineering Corporation** 28787 Aurora Road • Solon, Ohio

"Centralized" OIL AND GREASE SYSTEMS *"Meterflo"* CIRCULATING OIL SYSTEMS

METAL WORKING COMPOUNDS

(Conventional and Synthetic Bases)

FOR ALL TYPES OF MACHINING OPERATIONS

A quality SOLUBLE OIL BASE—conventional, non-transparent homogeneous coolant and cutting medium, high in lubricity and anti-weld qualifications.

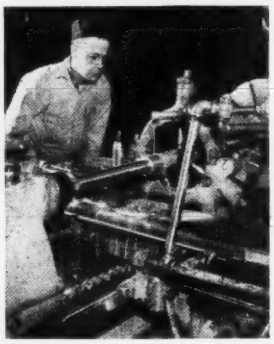
May be used in heavy emulsions or light solutions in working ferrous and non-ferrous stock. Its excellent wetting qualities accelerate settling out of sedimentation.

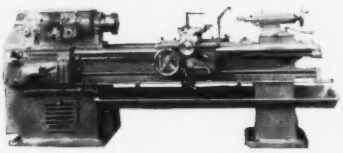
Hodson SOLUBLE OIL BASE has proved its superiority for use in large circulating and clarifying systems of mass production operations.

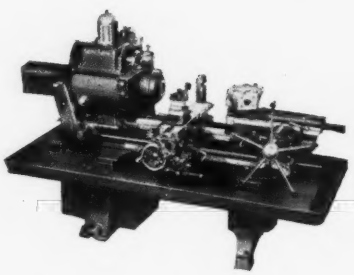
All types of machine tool procedures make effective use of these SOLUBLE OIL BASES in cutting, forming, threading and tapping.

The SYNTHETIC METAL WORKING COOLANT, is transparent—an organic phosphorous or petro chemical formulation modified with fatty derivatives and nitrogenous bases to give the cooling, oiliness, extreme pressure, anti-corrosion properties necessary for metal forming, grinding or machining—odorless—and free from any rancidity development.

The SYNTHETIC METAL WORKING COOLANT—GRINDING, also transparent, has excellent fall-out without wheel build-up, thus not requiring constant wheel dressing. Has extreme high heat and wet-out control.







CASE HISTORIES: Hundreds of successful machine tool operations in machining, grinding, broaching, etc. are on file, using both the conventional and synthetic base types.

The HODSON CORPORATION

Lubrication

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